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INFLUENCES OF WASTEWATER MANAGEMENT ON LAND USE: TAHOE BASIN 1950-1972

James E. Paper, et al

California University

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INFLUENCES ON WASTEWATER MANAGEMENT ON LAND USE: TAHOE BASIN 1950-1972

by
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and
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Contract No. 68-01-1842
Program Element 1HA095
21AZC/03

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FOREWORD

The widespread use of environmental impact analysis as a means of achieving Federal agency decision-making responsive to environmental concerns was initiated by the passage of the National Environmental Policy Act of 1969. The Act required that Federal agencies prepare statements assessing the environmental impact of their major actions significantly affecting the human environment. In subsequent years Federal agencies developed procedures for the preparation of environmental impact statements, often requiring similar analyses and statements from local governments and the private sector as a requirement for the award of Federal permits or grants. In addition, some states adopted environmental impact statement requirements. Recent revisions of guidelines for the preparation of Federal impact statements, issued by the Council on Environmental Quality, have defined clear requirements as to what can be expected in impact statements from Federal agencies. However, such uniformity of procedures and approach has not been extended below the Federal level on either Federal agency requirements or individual state requirements. Further, while the guidelines may specify what is desired in Federal impact statements, technical approaches to meeting these objectives may not always be available and universally acceptable.

As a part of its series of Socioeconomic Environmental Studies, the Environmental Protection Agency, Office of Research and Development, is conducting research whose objectives are to:

- Improve the technical quality of environmental impact analyses in areas of Agency responsibility.
- Improve the ability of the Agency to provide substantive technical review of environmental impact statements prepared by other agencies, and
- Improve the effectiveness of the use of environmental impact analyses in influencing decision-making at all governmental levels.

The Council on Environmental Quality's new guidelines requires that impact statements from Federal agencies also address the problem of stimulated growth associated with proposed actions and the environmental impact of that growth. This publication is part of a series of reports designed to assess such secondary impacts associated with highway and wastewater collection and treatment facilities. The report is a comprehensive analysis of the impact that wastewater facilities have had in a high mountain recreational area of national significance. The study was conducted by James E. Pepper and his Associates at the University of California, Santa Cruz, under contract from the Ecological Studies and Technology Assessment Branch, Implementation Research Division.

Edwin B. Royce, Director
Ecological Impact Analysis Staff
Washington Environmental Research Center

ABSTRACT

Statistical analysis indicates that wastewater infrastructure projects have had a significant influence on the land use pattern in the Lake Tahoe Basin. Land use densities have increased immediately following the expansion of plant capacities in areas serviced by three of the four major wastewater treatment facilities. The subdivision approval rate of raw land was also found to be a function of anticipated treatment capacity. Federal and state water quality agencies played an active and central role in wastewater management programs designed to remove the threat of water pollution at Lake Tahoe. Cooperation among all levels of government led to expeditious resolution of the water quality problem in spite of the numerous geographic, economic and political constraints in the region. However, the provision of sewerage facilities also removed land development constraints. Local governments, acting without coordinated land use policies, permitted intensive land uses which could not have occurred with septic tank treatment. These increases in land use have subsequently produced major environmental problems in the Tahoe Basin. Thus the singular focus on water quality led to unforeseen environmental impacts resulting from the land use changes made possible by the provision of extensive sewerage systems.

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SECTION I

CONCLUSIONS

The conclusions are logically organized into three general categories: the effects on environmental quality of the interaction of changing land uses and expanded wastewater management facilities; the impacts and influences of the provision of wastewater management facilities on land use patterns; and the influences of land use activities on the development of wastewater facilities.

Effects on Environmental Quality

The environmental problems attributed to land development in the Lake Tahoe Basin are the result of a combination of the inadequate exercise of land use controls and the growth-inducing influence of the provision of extensive advanced sewage treatment and export facilities.

The ineffectiveness of land use controls in maintaining environmental quality in the Tahoe Basin has been strongly influenced by a variety of factors. Prior to formulation of the Tahoe Regional Planning Agency (TRPA) Plan in 1970-71, local land use planners and decision makers failed to consider the impacts of proposed land uses on the fragile natural environment of the region. The magnitude of the adverse environmental effects resulting from the extensive subdivision activity in the Basin was not apparent until the slow, incremental process of actual residential construction reached a critical point, often many years after the subdivision approval.

Fragmentation of political jurisdictions and geographic remoteness of County Seats effectively excluded both permanent and seasonal residents from an active voice in the decision-making process. Furthermore, the remoteness from metropolitan areas did not allow for adequate protection of the state and national public interest in Tahoe Basin resources and amenities.

Provision of the extensive sewage treatment and export facilities in the Basin is largely the result of Federal and State agencies undertaking a strictly technological approach to wastewater management in order to remove the threat of septic pollution. Wastewater management programs were conceived and implemented without consideration of the consequent environmental problems associated with the potential land development and populations to be served by the projects.

Statistical analysis indicates that the provision and expansion of these wastewater management facilities has had a significant and direct influence on the location, type, and intensity of land development. Since the present environmental quality issues (including sedimentation, eutrophication, revegetation, scenic degradation, air pollution and traffic congestion) are a result of the pattern and type of land development and use, the role of wastewater management is directly related to these broader environmental quality issues.

Influences of Wastewater Management on Land Use Patterns

Land use planning and wastewater management planning were largely conducted as independent functions; there is little evidence to suggest that even minimum coordination has occurred.

Wastewater management officials have not played any direct or significant role in land use planning in the Tahoe Basin except for isolated cases where land development was temporarily denied on the basis of officially reported inadequate sewage treatment capacity. Wastewater management concerns were not a central consideration in the formulation of the TRPA Plan during 1970-1971. In spite of the magnitude of public investment in wastewater facilities in the Tahoe Basin (an estimated $82 million) the location of on-line facilities was not a factor in determining the population distribution indicated on the TRPA Plan.

Recently proposed wastewater management facilities have been acknowledged to be in conflict with the TRPA land use plan. A 1973 Environmental Impact Report prepared for the proposed expansion of the Tahoe City PUD system indicated that the project would encourage residential development in an area prohibited for development by the TRPA Plan. The responsibility for resolving the land use conflict was explicitly referred to the land use planning body and essentially avoided by the proponent agency.

Population estimates and projections used in wastewater facility calculations generally exceeded a reasonable interpretation of available data.

Estimates and projections of permanent, seasonal, and peak populations for the Tahoe Basin vary dramatically. The techniques used were generally based on questionable assumptions, lacked methodological rigor, and employed data of poor quality. The actual figures appear to range beyond reasonable tolerances necessary for responsible public decision-making.

The decision-making processes related to both land use development and the provision of wastewater facilities suffered from inadequate information.

In spite of the large public land ownership in the Basin (62%), and the magnitude of public investment in sewage facilities, public agencies consistently failed to develop adequate information in support of their decision-making processes. Numerous contradictions appear in available data. Although the TRPA subsequently developed a substantial set of data in the preparation of the regional plan, major data gaps still exist.

Limitations on water supply were not central considerations in wastewater management planning in spite of acknowledged water supply deficiencies in the Tahoe Basin.

Although the still unratified Bi-State Water Compact has identified the Tahoe Basin as a water deficient area and would place tight limitations on allocations of Basin water, the adequacy of water supplies has not been considered in wastewater management planning. As in the case of land use planning, there is little evidence of cooperation or concern between the public agencies responsible for these related functions.

The provision of wastewater management facilities has contributed to significant changes in the land use pattern in the Tahoe Basin.

Major expansions of wastewater treatment facilities have been directly followed by two substantial changes in the intensity of land use: the number of lots per acre has increased significantly in subdivisions; and large increases in higher density residential and commercial land uses have occurred.

In some cases subdivision activity has shown a strong statistical relationship to anticipated increases in treatment plant capacities. This may indicate that land speculation was stimulated by the anticipated provision or expansion of wastewater management facilities. Skiing and gaming activities correlated strongly with increased treatment capacity. Thus the availability of advanced sewage treatment may be considered as a great influence on the growth of intensive commercial recreation in the Tahoe Basin.

The increases in multiple family dwelling units and motel-hotel units shown have a similar relationship to increased plant capacity, and high-density residential and tourist accommodations may also be considered as uses dependent on the availability of wastewater treatment capacity.

Influences of Land Use on the Development of Wastewater Facilities

The determination of quantitative relationships indicating a direct influence of land use activities on the development of wastewater management facilities poses considerable difficulty due to the dynamic nature of the land development process in the Tahoe Basin.

It is clear that the initial impetus for providing wastewater management facilities was directly related to the septic pollution resulting from land use activities. The subsequent influences of land development are more problematic.

Provision of sewage treatment facilities has been explicitly acknowledged to be a precondition for the establishment of gaming facilities in the Nevada portion of the Tahoe Basin. However, no quantitative tests can determine the magnitude of influence of gaming interests on the development of wastewater facilities.

Although increases in commercial recreation and intensive residential uses show a strong statistical relationship to expanded treatment plant capacities, there is no available data which indicate a causal relationship between these land uses and the provision of sewage facilities.

Subdivision lot approvals provide the most complete and reliable land use time-series data, however no causal relationship was established measuring the influence of subdivision activity on the development of wastewater management facilities.

The planning and development of wastewater management facilities appears to have been considerably influenced by the development-oriented land use plans and policies of local governments.

The direct relationships between local or regional land use plans and wastewater management planning have proved difficult to establish. Prior to adoption of the TRPA Plan, local governments indicated very extensive acreages of land on their general plans for residential and commercial uses. Special districts with responsibilities for wastewater management expanded their boundaries accordingly to include these potentially developable lands.

Although the population figures used for actual wastewater sizing and phasing calculations were generally developed by independent consulting engineering firms, the population estimates and projections derived from data in local general plans had a considerable influence on the magnitude of consultants' figures.

SECTION II

RECOMMENDATIONS

The EPA should require that proposed wastewater management projects be consistent with environmentally based land use plans. Therefore the EPA should strengthen the grant review and environmental impact statement processes to require a thorough environmental quality assessment of land use plans for areas served or affected by proposed projects. An evaluation of the likely land use impacts of proposed projects would ensure that environmentally sound land use plans are not pre-empted by growth-inducing wastewater projects. If proposed wastewater management projects are found to support or induce growth which would lead to major adverse environmental impacts, the EPA should withhold funding. The priorities for project funding should support the resolution of serious water quality problems, but project capacities should be governed by the "growth-inducing--adverse environmental impact" relationship cited above.

The EPA grant review and environmental impact statement process should require a detailed discussion of the assumptions and methods used in population projections for facility sizing. Projects supported by feasibility studies which fail to conform to this requirement should not be approved.

The EPA should establish guidelines for developing the data base and methods necessary for local agencies to measure the potential growth-inducing impacts of federally funded wastewater management facilities. The actual development of information and methods should be undertaken by the appropriate local or state agency.

The EPA should undertake research on land use infrastructure relationships in areas with a more typical urbanization pattern and a richer data base than the Lake Tahoe Basin.

The EPA should encourage and support technical research to develop water-conserving and small scale sewage disposal systems that would be economically suitable for seasonal and second-home communities.

The EPA should require that TRPA prepare a sound regional wastewater management plan, prior to making further federal commitments to fund wastewater facilities in the Tahoe Basin.

The TRPA should identify and delineate additional air, water and land resource capabilities to strengthen the present Land Capability system. The composite of these resource capabilities may, in fact, limit even further the amount of urbanization which can be supported by the region's fragile environment without substantially lowering environmental quality. Therefore the TRPA should establish an information system to provide the necessary baseline data to monitor changes in population, land use, and environmental quality. The system should include consistent methods to standardize, catalog, store and retrieve data.

The TRPA should also establish a planning information base for all existing infrastructure systems, especially those requisite for land development, i.e., wastewater management, transportation, water supply, and energy. Data collection should include information on existing capacities, planned or projected patterns of system expansion, critical project sizes for economic efficiency, phasing of infrastructure elements in relation to each other, alternative technologies, and impacts or influences of the systems on the pattern of land use. This infrastructure information should be fully utilized in the ongoing TRPA planning process, especially in project and plan review or modification.

The TRPA should undertake a thorough study of the impact of water supply limitations on regional land use planning, particularly in view of the proposed Bi-State Water Compact allocations and the volume of domestic water required for the export of sewage from the Basin.

The TRPA should examine the spatial implications of its policies and of those of other agencies with authority over Tahoe Basin resources. Hypothetical consequences of various policies on the land use pattern are discussed in scenario form in Section VIII--Overview and Prospect.

SECTION III

INTRODUCTION

Statement of the Research Problem

The relationships between wastewater management systems and land use patterns are largely unknown. As extensive and advanced sewerage systems replace septic tanks or inadequate existing systems, changes in surrounding land use occur.

The aims of this research are:

1) to identify the type and magnitude of influences that the approval, construction, and operation of wastewater management systems have had on land use patterns and land use intensity in the Lake Tahoe Basin from 1950 to the present;

2) to determine and measure specific structural relationships between the location, capacity and timing of wastewater management systems, and the range of critical variables such as zoning, subdivision, interest rates, etc., which influence land development processes;

3) to express the relationships between wastewater management systems and land use patterns through appropriate qualitative and quantitative analytical methods;

4) to approach the research problem from a planning and policy analysis perspective; and

5) to develop a simple predictive method of expressing relationships between sewer service, population growth, land use, and environmental quality in the Tahoe Basin.

Infrastructure systems (wastewater management, transportation, water supply, energy, etc.) establish the structure and boundaries for the land development process. Often the relationship of infrastructure to development is direct and immediate (e.g., no construction is possible without roads to transport building materials; no occupancy permits are issued without water, sewer, and power hookups). The indirect influences of infrastructure systems on development are more difficult to determine and assess. It is clear however that the process of planning and regulating land use is a direct function of the development of infrastructure systems.

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Environmental quality issues provided the impetus for the research. The direct impacts of land use on environmental quality have been central issues in the Lake Tahoe Basin for two decades. However, wastewater management may provide a crucial link between land use and subsequent impacts on environmental quality. Figure III-1 illustrates the linkages among these three elements, and as an example traces a septic pollution problem and its technological solution through subsequent changes in land use and environmental quality.

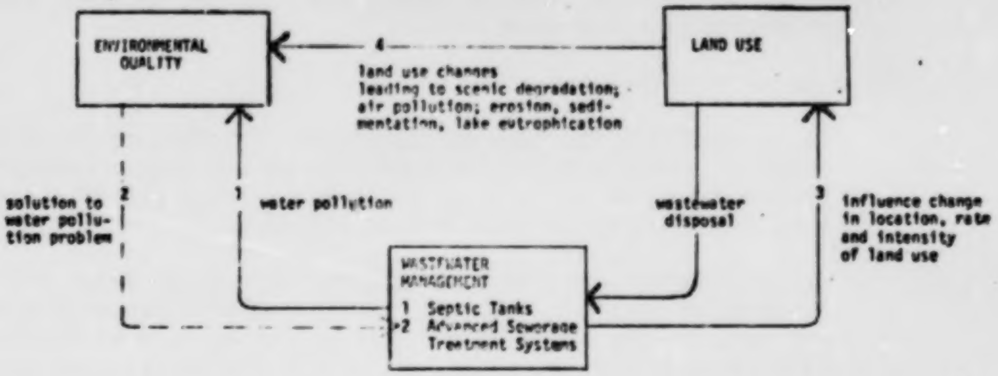

ENVIRONMENTAL QUALITY
4
land use changes leading to scenic degradation; air pollution; erosion, sedimentation, lake eutrophication
LAND USE
solution to water pollution problem
2
1
water pollution
wastewater disposal
3
influence change in location, rate and intensity of land use
WASTEWATER MANAGEMENT
1 Septic Tanks
2 Advanced Sewerage Treatment Systems

Figure III - 1: ENVIRONMENTAL QUALITY: RELATIONSHIPS BETWEEN LAND USE AND WASTEWATER MANAGEMENT

A water pollution problem (1) resulting from septic tank disposal of wastewater (generated by residential and commercial land use) was solved by the provision of advanced wastewater collection and treatment systems (2). These systems, with capacities to service an extremely large projected population, may have in turn significantly influenced the land use pattern (3) through stimulating or accelerating land development. The increased rate, density and extent of land use then contributed to a reduction in environmental quality (4) through increased soil erosion and sedimentation (thus increasing the likelihood of lake eutrophication). Air pollution and noise also increased appreciably from the magnitude of development. Substantial scenic degradation occurred from the development of steep, highly visible lands, and lands contiguous to the infrastructure corridor.

Although the three elements constitute a whole system, the research emphasis is directed at the interrelationships between the land use and wastewater management elements. Existing research is used to establish important relationships between these two elements and environmental quality.

Purpose and Scope of the Research

Since the Environmental Protection Agency should be directly concerned with all aspects of environmental protection relating to wastewater management, the research perspective was directed toward but not limited to the agency's functions in:

1) the review process for approving and administering clean water grants;

2) the preparation and review of Environmental Impact Statements;

3) the coordination of federal agencies involved in environmental protection issues;

4) the analysis, review and formulation of policy relating to comprehensive environmental protection programs;

5) the role of environmental protection in developing National Land Use Policies; and

6) the development of research programs related to the advancement of wastewater management technologies.

The research covers the time period from 1950-1972. During this period numerous factors such as new statutes, policies, studies and reports, plans changes in public attitudes and behavior, changes in public officials, etc., have influenced land development in the Tahoe Basin. Major policy changes in both wastewater management and land use planning have also occurred during the past 23 years. The consequent influence of these factors on the evolving land use pattern will be analyzed and evaluated.

The geographic boundary of the study is defined by the perimeter of the Lake's tributary watersheds, covering an area of approximately 500 square miles.

As a research area, the Lake Tahoe Basin presents an unusual combination of land use influences and determinants: the political geography includes portions of two states and six counties; the regional economy is dominated by the second home market, tourism and commercial recreation; land ownership is divided between the public and private sectors; the area is a scenic and recreation amenity of acknowledged national significance; and legalized gaming is present in the Nevada portion of the Basin. It is expected that the research findings will be directly applicable to other areas where these conditions occur, but must be appropriately modified under different conditions.

SECTION IV

ENVIRONMENTAL QUALITY ISSUES

A New Dimension in Public Policy

During the past decade growing national concern over the quality of the environment has led to the enactment of major environmental quality legislation at both the federal and state levels. The passage of the National Environmental Policy Act (NEPA) in 1969, and the creation of the Environmental Protection Agency in 1970 are milestones in the quest for quality of both life and environment. Section 102C of NEPA, which requires the preparation of an Environmental Impact Statement prior to any federal action (project) which might have a significant effect on the human environment has placed the concept of environmental impacts squarely within the public decision-making process.

Initially, emphasis was placed on determining the direct and immediate physical impacts of a project. Subsequently, concern over the land use impacts of a project prompted the Council on Environmental Quality (CEQ) to require consideration of growth-inducing impacts in the preparation of Environmental Impact Statements (CEQ, 1973). Thus the scale and type of analysis necessary to identify and evaluate impacts has changed significantly (Sorensen and Moss, 1972).

By factoring generic impacts such as water pollution, noise, earth movement, scenic loss, etc., into specific environmental condition changes, definitive environmental costs and benefits of a project can be determined (Sorensen and Pepper, 1973). Only if these impacts can be expressed in terms of social or economic costs or benefits can environmental quality be systematically included in a rational decision-making process.

A substantial amount of research has been conducted on direct and secondary impacts of specific project types including wastewater collection and treatment systems (Sorensen and Pepper, 1973). However, since the land use changes resulting from a project remain undetermined, an assessment of the total magnitude of environmental impacts resulting from a project remains extremely limited.

It is clear that an accurate and complete assessment of the environmental impacts of an infrastructure project should include the impacts of land use changes resulting from the project. Without this information the cumulative impacts of a project cannot be included in the calculus of project costs and benefits.

The Issue at Lake Tahoe

The environmental quality issue has been central to land use planning and management in the Tahoe Basin for decades (Jackson and Pisani,1972; 1973). As the region changed from a resort area to what is now a rapidly urbanizing recreation center, concern for environmental quality reached the state and federal levels.

In 1967 an extensive report issued by the (bi-state) Lake Tahoe Joint Study Committee declared:

> there is a distinct risk that, unless public policy arrests present trends, there will be a cumulative degeneration in the overall environment of the Lake Tahoe Region (Lake Tahoe Joint Study Committee, 1967, p. 9).

The committee clearly recognized the source of environmental degeneration in stating, "the basic pressure upon the carrying capacity of the Region arises from the over-intensive use of land (and space)" (Lake Tahoe Joint Study Committee, 1967, p. 9).

In 1969 Congress consented to the California-Nevada Tahoe Regional Planning Compact, thus establishing the Tahoe Regional Planning Agency (TRPA). The enabling legislation findings state:

> It is found and declared that the waters of Lake Tahoe and other resources of the Lake Tahoe region are threatened with deterioration or degeneration, which may endanger the natural beauty and economic productivity of the region. (U.S. Congress, 1969, p. 1).

In creating the TRPA the compact states, " . . . it is imperative that there be established an area-wide planning agency with power to adopt and enforce a regional plan of resource conservation and orderly development . . ." (U.S. Congress, 1969, p. 1) The control of land use is directly established as the means of addressing environmental problems.

Widespread citizen concern for environmental quality is evident from the results of a Lake Tahoe Area Council survey in 1971 of the 26,000 property owners in the Tahoe Basin (Lake Tahoe Area Council, 1971a). A tabulation of the 8000 questionnaire responses ranks water pollution, scenic destruction, too much commercialism and too many people as the major environmental problems. Seventy-three percent of the respondents indicated that present land use and government controls were not strict enough, with over a third of the property owners stating they would favor condemning private land for public use. These results provide very strong evidence of the magnitude of public concern for the quality of the Tahoe environment.

Scientific research adds yet another dimension to the environmental quality issue in the Lake Tahoe Basin. Extensive research has been published on the problems of water pollution and scenic degradation (Matthews and Schwarz, 1970). Considerable conclusive water quality research has been conducted at Lake Tahoe over the past decade (Goldman, 1972; Goldman et al., 1970; 1972; 1973; U.S. Department of Interior, 1966; California Department of Water Resources, 1968-72).

In addition, research attention has recently been directed towards the influence of the land use pattern on water quality (U.S. Forest Service, 1972) and visual amenities (McEvoy and Williams, 1970). Some research on specific land use impacts on water quality has been conducted (Glancy, 1971; 1973) but the results are inconclusive due to the limited time period used for observation and data collection. It is reasonable to assume, however, that the location, intensity and rate of land development are the causal factors leading to reduced water quality and scenic degradation in the Lake Tahoe Basin.

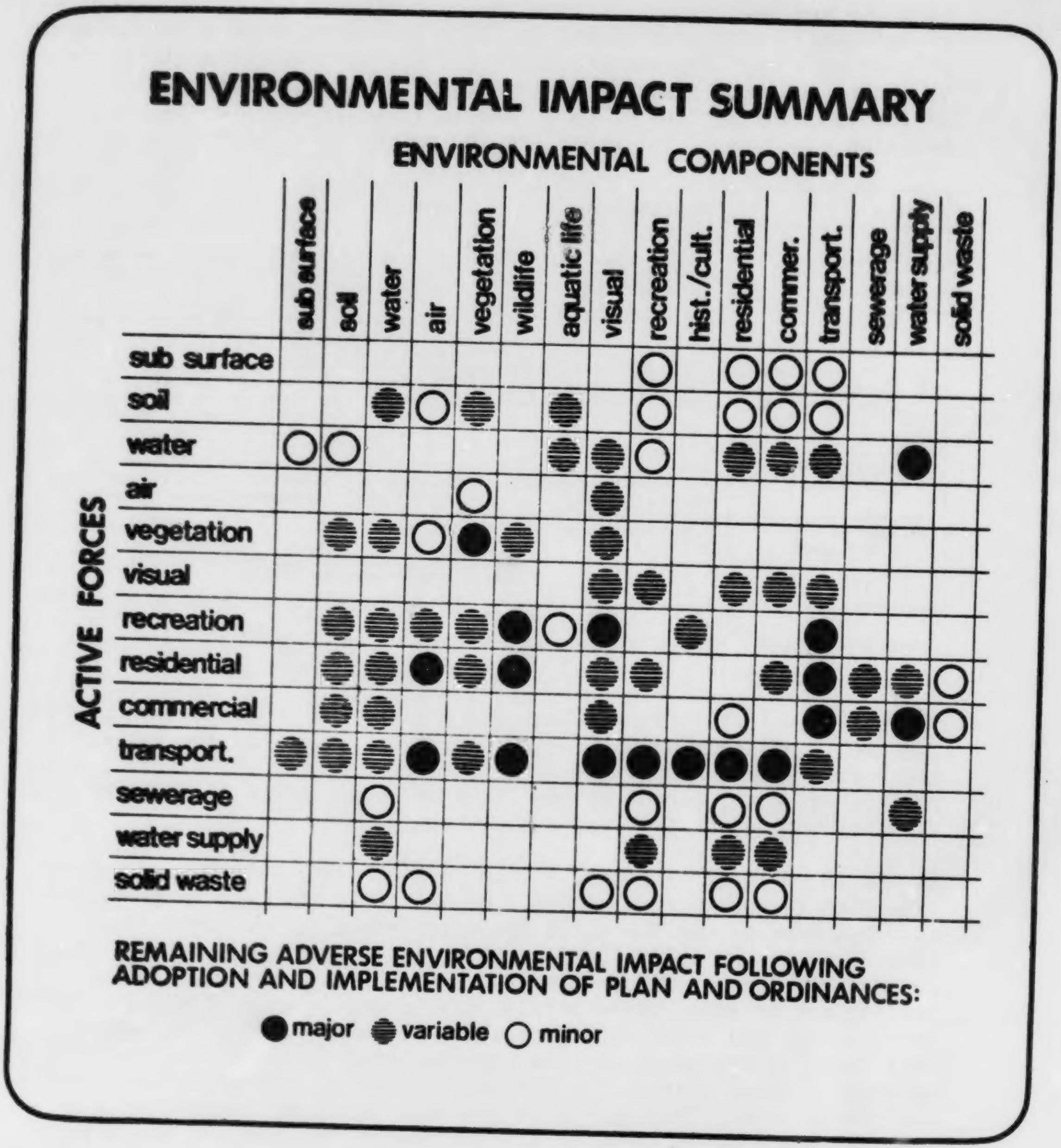
In 1972 an extensive analysis of environmental quality was undertaken by a TRPA consultant under contract to prepare an Environmental Impact Statement on the Lake Tahoe Comprehensive Plan (Wirth and Associates, 1972). Both the plan and implementing ordinances were assessed to determine their effectiveness in dealing with the potential adverse environmental changes resulting from the full implementation of the plan.

A summary of impacts, as determined by the consultant, is shown in Figure IV-1. Several important observations may be made from these findings. First is that fifteen of the seventeen major adverse impacts identified are attributed to recreation, residential, and commercial land uses and the related transportation infrastructure. Second, sewage treatment, the acknowledged major environmental quality issue during the 1960's, is indicated as producing no major adverse impacts (although one variable impact and four minor impacts were identified). Third, the relationship between wastewater management (sewerage) and the impact-generating land uses is not indicated.

The consultant was unable to establish a connection between wastewater management and the impact-generating intensive land uses dependent on the extensive sewerage facilities in the Tahoe Basin. This relationship between wastewater management and land use impact is vital to an accurate and complete understanding of this impact summary.

Land Use

Although this research is not directed at either land planning theory or land development theory, a brief discussion of a simple conceptual framework in which they fit is appropriate in order to provide a context for the sections which follow.



ENVIRONMENTAL IMPACT SUMMARY

ENVIRONMENTAL COMPONENTS

ACTIVE FORCES	sub surface	soil	water	air	vegetation	wildlife	aquatic life	visual	recreation	hist./cult.	residential	commer.	transport.	sewerage	water supply	solid waste
sub surface									○		○	○	○			
soil			▤	○	▤		▤		○		○	○	○			
water	○	○					▤	▤	○		▤	▤	▤		●	
air					○			▤								
vegetation		▤	▤	○	●	▤		▤								
visual								▤	▤		▤	▤	▤			
recreation		▤	▤	▤	▤	●	○	●		▤			●			
residential		▤	▤	●	▤	●		▤	▤			▤	●	▤	▤	○
commercial		▤	▤					▤			○		●	▤	●	○
transport.	▤	▤	▤	●	▤	●		●	●	●	●	●	▤			
sewerage			○						○		○	○			▤	
water supply			▤						▤		▤	▤				
solid waste			○	○				○	○		○	○				

REMAINING ADVERSE ENVIRONMENTAL IMPACT FOLLOWING ADOPTION AND IMPLEMENTATION OF PLAN AND ORDINANCES:

● major ▤ variable ○ minor

Figure IV - 1: TRPA REGIONAL PLAN: ENVIRONMENTAL IMPACT SUMMARY

Source: Wirth and Associates, 1972

Land use and development factors may be expressed at specific levels of influence, each significant in the actual process of determining or allocating uses. Five distinct levels, moving from the abstract to the concrete, have been identified as contributing to the evolution of the land use pattern at Lake Tahoe. These levels and their expression and type of influence are indicated in Table IV-1.

LEVEL	EXPRESSION	INFLUENCE
1) Philosophical	Societal Values toward land: Attitudes/Values in individual behavior	Degree of private/public balance in land use planning, decision-making and land use regulation (see levels 3 and 4)
2) Statutory	Laws	Sets the statutory context for behavior of both the public and private sector in land planning and development
3) Conceptualized Development	Plans and Policies (Public and Private)	Generates expectations; give indications of planned uses thus alters behavior of both public and private sectors; can increase or decrease land values.
4) Legally Committed Development	Institutional/Jurisdictional Permits and Development Approvals	Permits owner(s) to undertake development for specified use; essentially results in establishing a legally available (potential) use capacity.
5) Physical Development	Actual Development	Physical impacts on both institutional and infrastructural capacities; physical inputs on environmental quality; generates demands for related development or uses.

Table IV - 1: GENERIC INFLUENCES ON THE LAND DEVELOPMENT PROCESS

The philosophical level will not be investigated in the course of this research, but nonetheless remains the key influence in the values associated with the use of land. Level two, statutory, is not a topic of this research, except as the statutory exercise or lack thereof has directly influenced the land use pattern.

At the third level of conceptual or planned uses, future land use is expressed through plan maps and documents. In the Lake Tahoe Basin such planning became the basis for calculating future populations (Brown and Caldwell, 1959), for sizing public facilities (Hill, 1969), for determining potential local revenues (South Tahoe PUD, 1960), for guiding and/or encouraging private development (Smith, 1960) and for stimulating land sales and speculation (Trimont, 1970). In addition this level is the basis for the commitment of state and federal revenues (loans, grants) for the development of infrastructure, housing assistance, etc. This points up the importance and significance of land use planning in terms of its subsequent influence on the actual use pattern and the consequent impacts on environmental quality.

The fourth level, the legal commitment to land uses, is expressed primarily through the mechanisms of zoning and subdivision rights and building permits (see Appendix B). Property rights are created by the state. Once government has made the commitment to grant land use rights, any decision to rescind these rights becomes extremely difficult. The legal commitment of land use rights far in excess of the actual exercise of those rights may create a condition where environmental degradation becomes extremely difficult to avoid. This is clearly the case at Lake Tahoe where 30,000 legally subdivided lots lie vacant (Economic Research Associates, 1972a),with the consequent impacts of their full development unknown.

Political trade-offs are constantly made during the transition from the philosophical to the legal level, but only at level five--construction, occupancy, and activities--are the full range of actual impacts on the land use pattern felt. Since these impacts alter social, economic, and environmental systems they require careful monitoring and evaluation in order to provide constant feedback to the conceptual and legal levels as the land development moves into its physical expression.

Changes in environmental quality which may disrupt an ecosystem are difficult to predict (Detwyler, 1971). Often these changes become evident only after a threshold has been crossed. In the absence of clearly defined environmental thresholds, the smaller the difference between the physical, legal, and conceptual expressions of the use pattern, the greater is the possibility for positive response to emerging environmental problems. The amount of congruence between these three levels of commitment provides a key indicator of the ability of a regulatory body to respond to emerging environmental quality land use problems. Figure IV-2 illustrates this problem.

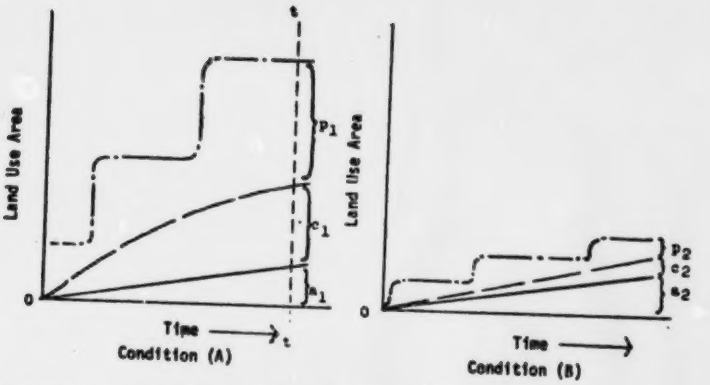


Figure IV - 2: CONGRUENCE AMONG LAND USE LEVELS AS AN INDICATOR OF RESPONSIVENESS TO ENVIRONMENTAL POLICY

In condition A, a considerable disparity exists between the amount of land actually being used (a_1) and the amount of land legally committed through subdivision and zoning (c_1). The disparity between the committed and planned land use (p_1) is also considerable, and the aggregate difference between actual and planned use (c_1+p_1) is of major magnitude.

Environmental impacts can only result from actual use of land. Thus impacts occur when the type or intensity of actual use produces a change in environmental conditions. Once an impact and its causal factors are identified, the question becomes one of effectively controlling undesired consequences. The congruence between actual land use and committed or planned land use is central to this question.

A policy adopted at time t (figure IV-2, condition A) to control environmental impacts generated by the actual land use (a_1) must necessarily address the problem of rescinding or significantly reducing the level of committed and planned land uses (c_1 and p_1). As noted earlier this is an extremely difficult process wrought with complex legal and financial problems.

Therefore if land development as expressed through planning and legal commitment is intended to control environmental impacts, the disparity among levels must be minimized as indicated in Figure IV-2, Condition B. It is the degree of congruence which determines the effectiveness of land use control mechanisms in addressing environmental quality issues.

SECTION V

CHARACTERISTICS OF THE LAKE TAHOE BASIN

The ecological and societal characteristics of the Tahoe Basin are both complex and unusual. This section provides a summary of the most important factors influencing the nature of land uses and activities which developed in the Tahoe Basin. The discussion is necessarily brief, intended only to outline a context for the analytical sections which follow.

This material is organized into two distinct parts. The first describes significant characteristics important to the study area. The second consists of a formulation of a general model which provides a structure for the factors shaping land use in the Tahoe Basin and identifies three distinct periods in the evolution of the land use pattern.

Physical and Biological Characteristics

Lake Tahoe is one of the world's few primordially pure alpine lakes. Bounded on the west by the crest of the Sierra Nevada (California) and on the east by the Carson Range (Nevada),the 200 square mile deep-water lake is of legendary beauty as it possesses unusual clarity and purity and is surrounded by towering granite peaks. With its 300 square mile watershed of Sierra Nevada landscape, it provides a natural amenity of acknowledged national significance (U.S. Senate, 1972a), and a recreational amenity of high regional value.

The combination of long dry summers, frequent periods of extended drought alternating with periods of heavy rainfall, a short growing season and highly erodable soils, all contribute to the fragile nature of the Tahoe Basin environment (Tahoe Regional Planning Agency, 1971g).

Perhaps the most important ecological factor is the relationship between the quality of the water in the lake and the quality of the water in the 64 watershed tributaries. With the notable exception of a gentle shoreline band, the topography is generally quite steep, making streams highly susceptible to damage from siltation due to the crumbly granitic soils characteristic of the region (TRPA, 1971g). The short growing season significantly limits revegetation (TRPA, 1971h). Once the vegetative cover is removed or disturbed, soil erosion occurs and the high drainage densities of the watersheds provide rapid sediment transport to the lake (U.S. Forest Service, 1972).

The impact of this increased sediment discharge on water clarity and quality is the subject of current research by the Nevada Department of Conservation and Natural Resources (Glancy, 1971; 1973), and Goldman's research at the University of California, Davis, investigating accelerated eutrophication in Lake Tahoe (Goldman 1970; Goldman *et al.*, 1970; 1973).

In such a delicate self-contained ecosystem, a threshold exists beyond which deterioration is either irreversible or arrestible only at prohibitive cost. The risk of permanent degradation encompasses not only the lake, but the entire landscape; that is, not only the natural resource base, but the regional economy and the quality of life in the region as well (Lake Tahoe Joint Study Committee, 1967).

The high scenic value of the region is also related to atmospheric visibility; the views and vistas across the lake are of outstanding quality. In recent years inversion layers which trap smoke and vehicle exhaust fumes have significantly reduced visibility (TRPA, 1971). The topographic features of the basin sharply define a contained airshed with atmospheric conditions susceptible to inversion problems.

Much has been written about the physical and biological characteristics of the Lake Tahoe Basin. A compilation and synthesis of publications and data issued jointly by the TRPA and the U.S. Forest Service in 1971 covers the subjects of climate and air quality, geology and geomorphology, hydrology and water resources, limnology and water quality, soils, vegetation, wildlife, fisheries, land resources, recreational resources, scenic analysis, and cultural and historical significance. In 1969 a Lake Tahoe Basin bibliography was published by the California Resources Agency and the U.S. Forest Service, compiling 101 pages of bibliographic references covering history, legal controls, physical and biological characteristics, planning, and water quality (Matthews & Schwartz, 1970).

Social and Economic Characteristics

The Lake Tahoe Basin is the major mountain resort area for northern California. San Francisco, Sacramento and Reno are within easy driving distance (Figure V-1).

The social fabric is unusual due to the contrast between the permanent population, composed predominately of lower income service and trade personnel, and seasonal residents and short term visitors, who are primarily higher income families from northern California urban areas. Over a half-million families with annual incomes in excess of $10,000 are in the region's primary market area, exerting an extraordinary demand on the housing and recreation resources (Economic Research Associates, 1971).

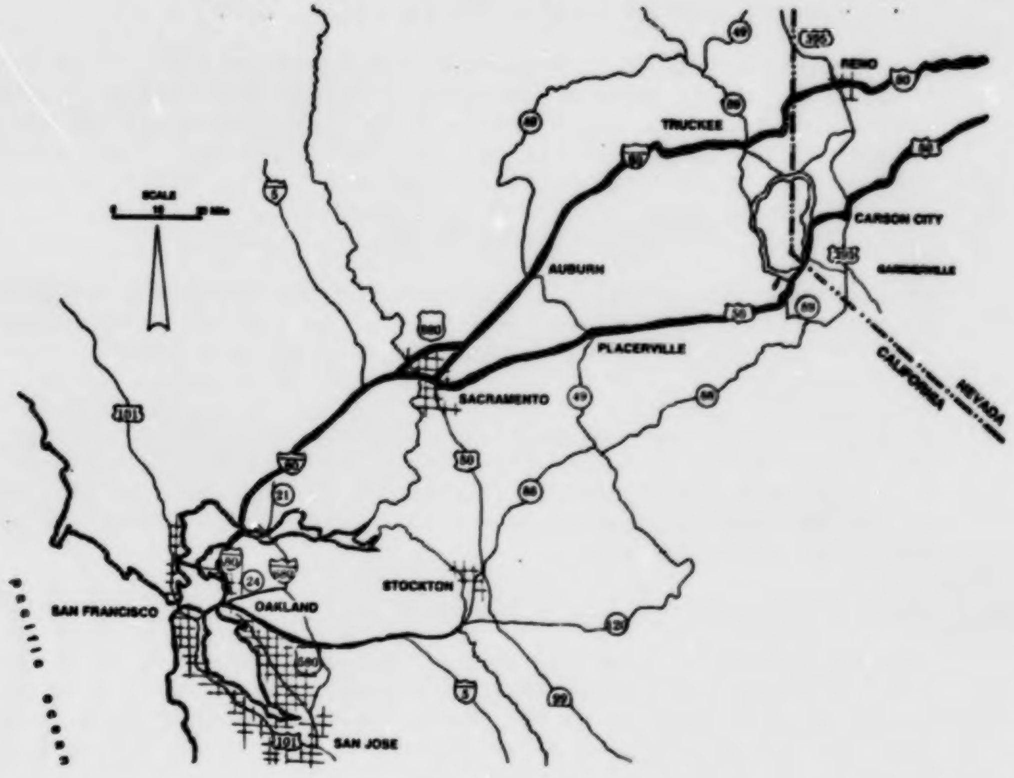

SCALE
0
10
TRUCKEE
RENO
CARSON CITY
GARDNERVILLE
AUBURN
PLACERVILLE
SACRAMENTO
CALIFORNIA
NEVADA
STOCKTON
OAKLAND
SAN FRANCISCO
SAN JOSE
pacific ocean
395
80
50
89
49
101
5
99
120
580
24
88
680
21
28

Figure V - 1: LAKE TAHOE LOCATION MAP

Source: EPA Lake Tahoe Study

The economy is primarily recreation-based. Second homes, apartments, condominiums, and motel-hotel accommodations house a substantially larger population than the 26,000 permanent residents (ERA, 1972a). Although high vacancy rates exist in the Basin, the cost of renting or buying housing is considerably above the reach of most service and trade personnel. High land and construction costs are cited as the basis for this serious housing shortage (ERA, 1972a).

Legalized gaming has been present in the Nevada portion of the region since 1955. It is largely concentrated around the north and south stateline areas. The rapid growth of tourism, gaming, skiing and outdoor recreation activities has resulted in peak day populations estimated to be as large as 248,000 persons (Smith, 1971), although other estimates range from 98,000 (Walters, 1973) to 155,000 (Eckbo et al., 1973b) (see Table VI-8).

Very little research has been conducted on the social and economic characteristics of the Lake Tahoe Basin. Most of the published material in these subject areas is confined to consultant reports to special districts, land developers, or local government. These documents are generally not research findings per se and therefore provide a very uneven description of social and economic activity. The only attempts at systematic compilation and analysis occur in the "1980 Regional Plan Technical Supplement" (Wilsey and Ham, 1967) and in the two studies prepared by Economic Research Associates for the TRPA (ERA, 1971; 1972a).

Institutional and Regulatory Characteristics

Sixty-two percent of the region's landscape is in public ownership. The U.S. Forest Service administers 57% (see Figure V-2) while the remaining 5% is managed by the respective State Park systems. These public holdings provide a major recreation opportunity for northern California and Nevada residents. In addition they provide a significant external economy to the resident population, because the outstanding natural amenities contained within the Basin are a major asset to the recreation-based economy (Lake Tahoe Joint Study Committee, 1967).

The Tahoe Basin contained over one hundred special-purpose authorities, one incorporated city,portions of six counties and two states, and is served by numerous Federal and State agencies. Prior to formation of TRPA in 1970, land use planning and decision-making took place at the respective county seats, all located a considerable distance from the Tahoe Basin (Figure V-3). The City of South Lake Tahoe, incorporated in 1965, has been the sole exception. The myriad of land use regulation problems in the Lake Tahoe Basin has been well researched and documented (Brandt, 1971; Bronson, 1971; Constantini, 1972; Davis, 1970; Felts and Wandesforde-Smith, 1973; Hopp and Linn, 1970; Lake Tahoe Joint Study Committee, 1967; U.S. Senate, 1972a).

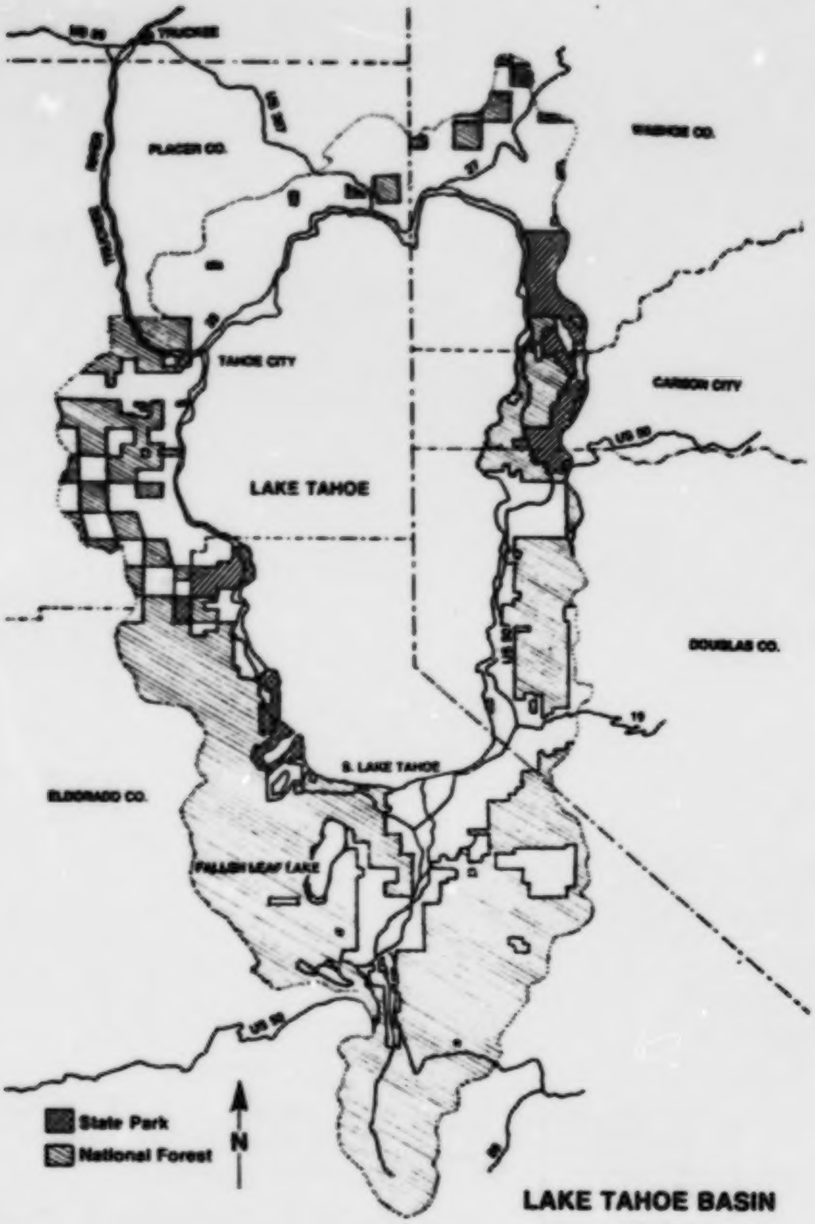

TRUCKEE
PLACER CO.
WASHOE CO.
TAHOE CITY
CARSON CITY
US 50
LAKE TAHOE
DOUGLAS CO.
S. LAKE TAHOE
ELDORADO CO.
FALLEN LEAF LAKE
▨ State Park
▨ National Forest
N
LAKE TAHOE BASIN

Figure V - 2: PUBLIC LAND OWNERSHIP -- LAKE TAHOE BASIN

Source: EPA Lake Tahoe Study

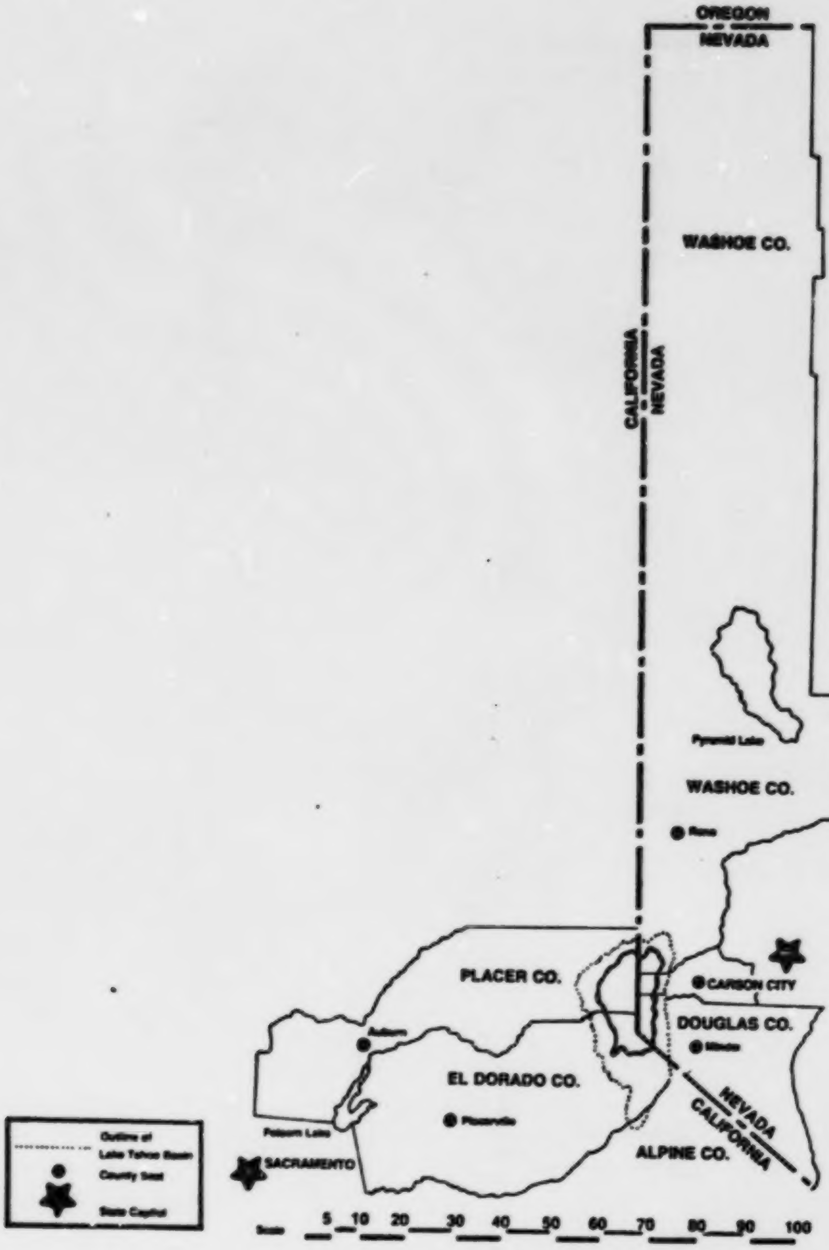

OREGON
NEVADA
WASHOE CO.
CALIFORNIA
NEVADA
Pyramid Lake
WASHOE CO.
Reno
PLACER CO.
CARSON CITY
DOUGLAS CO.
Minden
Auburn
EL DORADO CO.
Placerville
NEVADA
CALIFORNIA
ALPINE CO.
Folsom Lake
SACRAMENTO
Outline of Lake Tahoe Basin
County Seat
State Capital
Scale
5
10
20
30
40
50
60
70
80
90
100

Figure V - 3: POLITICAL GEOGRAPHY -- LAKE TAHOE BASIN

Source: EPA Lake Tahoe Study

State and federal involvement in the development and administration of wastewater management has been substantial. However, wastewater systems are directly provided by eleven special districts (Figure V-4). Four export facilities are in operation pumping virtually all wastewater out of the Tahoe Basin (Figure V-5). Almost all of the districts were established and consolidated during the research period (see Table VI-15).

Publications on water pollution and wastewater management problems are numerous. More than seventy bibliographic entries in this research deal directly with wastewater management problems specific to Lake Tahoe. This proliferation underscores the magnitude of both the problem and the concern. Unfortunately, no comprehensive picture of wastewater management can be drawn in the aggregate (see Section VII-Policy Analysis and Evaluation).

Growth and Development Context

The purpose of this brief discussion is twofold: first, to identify major elements shaping land use in the Lake Tahoe Basin, including the relationships among these elements; and second, to identify the sequence of significant changes in the elements and their interrelationships. A conceptual model is established of the land use system in the Lake Tahoe Basin to provide an historical context for the analysis and evaluation which follow. (A detailed chronology of important events in the evolution of the land use pattern and wastewater management is presented in Appendix A.)

This discussion draws on the characteristics previously described in this section as well as monographs in the area of land use planning, modeling and systems analysis (Chapin, 1965; Friedmann and Alonso, 1964; Hamilton, 1969; Milgram, 1967; Steinitz and Rogers, 1968).

Conceptual Model

The technique of modeling once resided solely in the domain of the physical sciences. With the help of systems analysis, modeling has recently been brought to a level of applicability which makes it useful to social scientists as well. Its main function is to explain interrelated phenomena. The main advantage of modeling over other forms of analysis is that it can explicitly express relationships within a total system.

It is important to note that the model developed in this section is a structural formulation of the factors shaping land use in the Tahoe Basin, not a quantified mathematical expression of absolute changes in land use measures. These changes cannot be projected because research findings indicate that data on land use activities is of poor quality, has many gaps and covers a period of major and irregular change which is also too short to allow a sufficient number of observations.

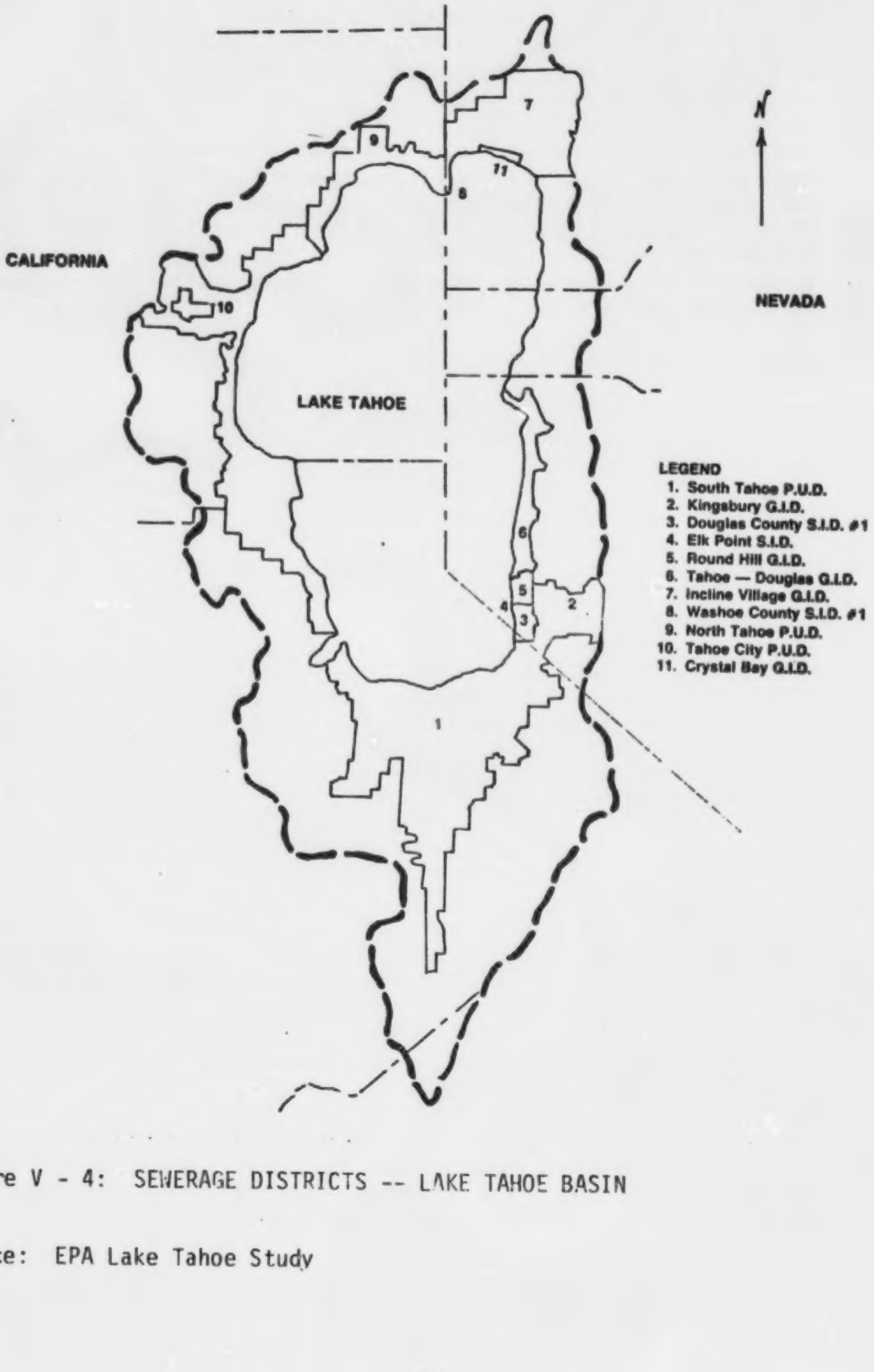

CALIFORNIA
NEVADA
LAKE TAHOE
N
1
2
3
4
5
6
7
8
9
10
11
LEGEND
1. South Tahoe P.U.D.
2. Kingsbury G.I.D.
3. Douglas County S.I.D. #1
4. Elk Point S.I.D.
5. Round Hill G.I.D.
6. Tahoe — Douglas G.I.D.
7. Incline Village G.I.D.
8. Washoe County S.I.D. #1
9. North Tahoe P.U.D.
10. Tahoe City P.U.D.
11. Crystal Bay G.I.D.

Figure V - 4: SEWERAGE DISTRICTS -- LAKE TAHOE BASIN

Source: EPA Lake Tahoe Study

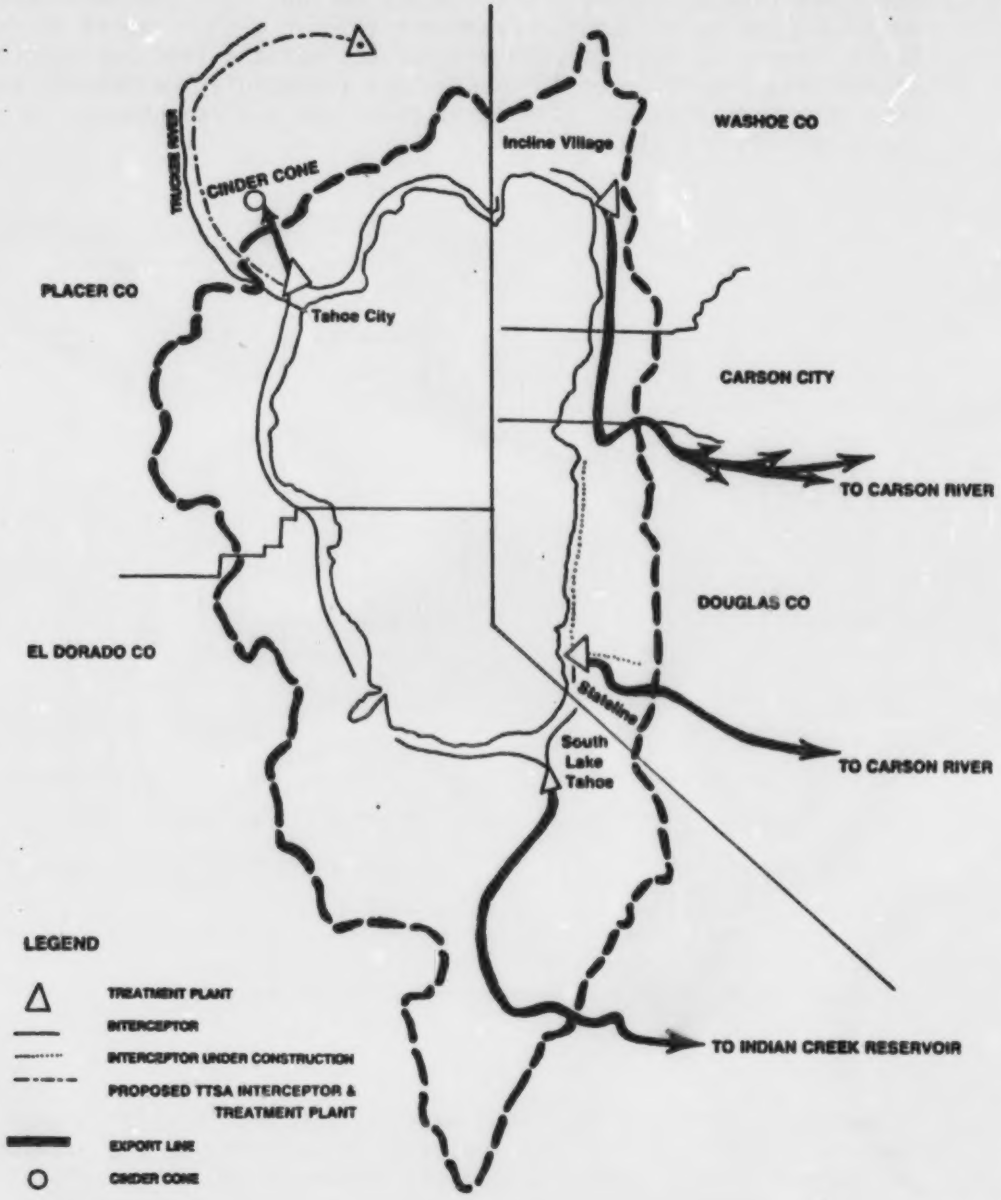

TRUCKEE RIVER
CINDER CONE
Incline Village
WASHOE CO
PLACER CO
Tahoe City
CARSON CITY
TO CARSON RIVER
DOUGLAS CO
EL DORADO CO
Stateline
South Lake Tahoe
TO CARSON RIVER
TO INDIAN CREEK RESERVOIR
LEGEND
TREATMENT PLANT
INTERCEPTOR
INTERCEPTOR UNDER CONSTRUCTION
PROPOSED TTSA INTERCEPTOR & TREATMENT PLANT
EXPORT LINE
CINDER CONE

Figure V - 5: SEWAGE TREATMENT PLANTS AND EXPORT LINES -- LAKE TAHOE BASIN

Source: EPA Lake Tahoe Study

A model of land development at Lake Tahoe must include those elements which are present throughout the study period. Six elements were determined to be of major consequence (Figure V-6): demand for Tahoe Basin resources; resident and visitor activities; land use control mechanisms; provision of infrastructure (especially wastewater management systems); physical land development and use and changes in environmental quality.

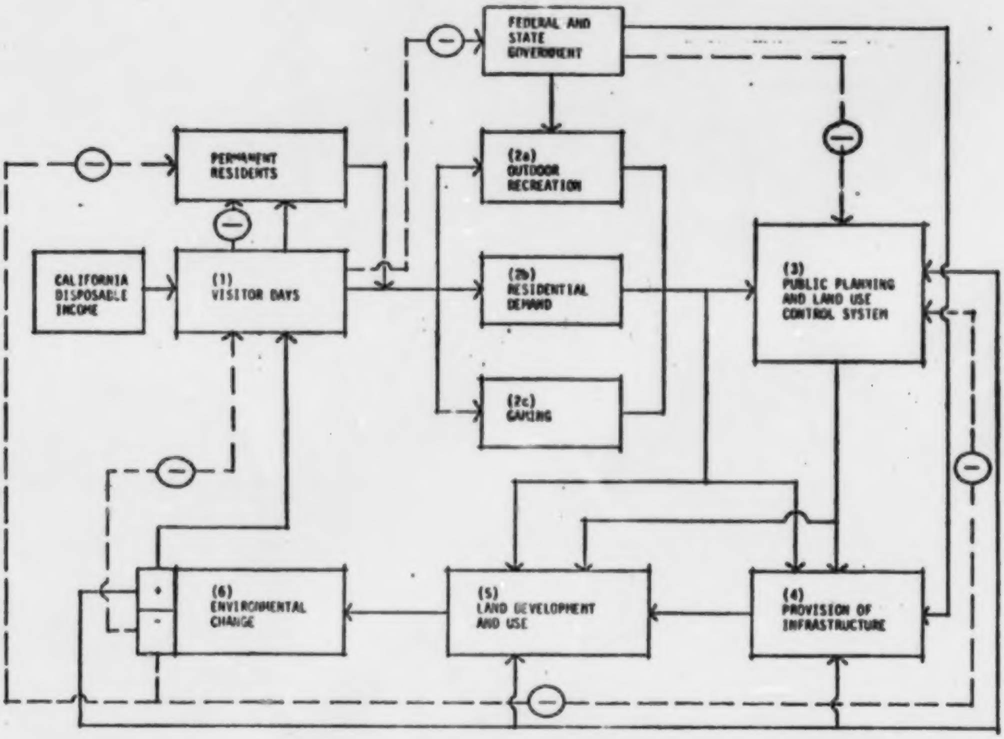

FEDERAL AND STATE GOVERNMENT
PERMANENT RESIDENTS
(2a) OUTDOOR RECREATION
CALIFORNIA DISPOSABLE INCOME
(1) VISITOR DAYS
(2b) RESIDENTIAL DEMAND
(3) PUBLIC PLANNING AND LAND USE CONTROL SYSTEM
(2c) GAMING
+
-
(6) ENVIRONMENTAL CHANGE
(5) LAND DEVELOPMENT AND USE
(4) PROVISION OF INFRASTRUCTURE

Figure V - 6: CONCEPTUAL MODEL OF THE LAND DEVELOPMENT PROCESS: LAKE TAHOE BASIN 1950-1972
Dashed lines indicate negative feedback

Element One -- Demand for Tahoe Basin Resources: A chief source of demand, and perhaps the best indicator of activity, is the growing population of high income California residents who can easily visit the Tahoe Basin. A 1971 economic study indicates that the primary Tahoe market is located in California and is comprised of over one-half million families with annual incomes in excess of $10,000 (ERA, 1971). Counts of annual visitor days provide the best indicator of actual demand.

Element Two -- Resident and Visitor Activities: This demand can be summarized in three activities: outdoor recreation including skiing, hiking, camping, fishing, swimming, beaching, picnicking; residential development for both seasonal and permanent residents; and gaming and other commercial facilities for tourists. It is important to note that gaming activity is regulated by the State of Nevada and is not subject to local or regional authority.

Each of these activities produces an impact on the region which can be expressed in economic, political, environmental and land use terms. Both public and private sectors contend for land use decisions favorable to their respective interests or activities. The private sector elements most active in this respect are developers and those with gaming interests who have title to land upon which their economic interests are to be advanced or contrained. By contrast outdoor recreation activities generally utilize public lands.

However a public/private conflict is intrinsic to these Basin activities when viewed in terms of environmental quality and compatible land uses. The environmental quality of the extensive public land holdings is acknowledged to be significantly degraded by the intensive private sector commercial activity occurring on private lands. The ultimate outcome of this conflict takes on transcendent importance when viewed in the context of Tahoe's extraordinary environmental amenities.

Element Three -- Land Use Control Mechanisms: Residential and commercial land use activities are regulated through a variety of publicly controlled mechanisms involving state, regional, and local government authorities (see Appendix B). Planning and regulation of public lands resides at the federal and state levels through the U.S. Forest Service and the respective state park systems.

Element Four -- Provision of Infrastructure: Infrastructure, which includes systems for water supply, energy, transportation, communication, solid waste disposal, and wastewater management, is provided by a sizeable number of semi-autonomous public, quasi-public and private bodies. This research is primarily concerned with wastewater management. Other infrastructure systems are discussed when they directly influence the relationships between wastewater management and land use.

Element Five -- Physical Land Development and Use: The visible expression of resource demand, land use regulation and provision of infrastructure is embodied in the resultant pattern of physical land development and use. Thus this element is the output of interactions among the previous four elements.

Element Six -- Change in Environmental Quality: This element is an expression of the changes in environmental quality resulting from the physical development and use of land. The element is the source of feedback which influences the level of demand and the degree of land use control.

Interrelationships Among Elements: Solid lines indicate the primary positive relationships between elements, defining a set of self-reinforcing or growth-sustaining relationships. The broken lines indicate negative feedback (self-correcting) relationships originating from adverse changes in environmental quality. This feedback loop is central to the evolution of land use controls in the Tahoe Basin.

Development Periods

The changes in these elements and relationships have been irregular in terms of both rate and degree. Elements may change gradually at a constant rate or increase by several degrees of magnitude. Relationships may remain constant or shift dramatically with changes in public attitudes or with new legislation. Therefore any determination of discrete historic periods is necessarily limiting. However the major changes in the Lake Tahoe land development process suggest the existence of three distinct periods, although precise dates of transition are somewhat arbitrary. These three periods and their important characteristics are shown in Table V-1. Section VIII of this report is a formulation of specific models for these three periods, based on the research findings presented in the quantitative and policy analysis sections which follow.

PERIOD	DATES	MAJOR LAND USE ACTIVITIES	LAND USE PLANNING AND REGULATION	WASTEWATER MANAGEMENT	ENVIRONMENTAL QUALITY ISSUES	MAJOR LEGISLATION
ONE	up to 1959	second homes summer outdoor recreation	local govt	primarily septic tanks with limited local sewage treatment facilities	water pollution from septic tanks	Interstate Water Compact Commission
TWO	1960-1969	second homes summer outdoor recreation skiing gaming seasonal recreation	local govt with transition leading to regional govt	major expansion of sewage treatment facilities decision to export effluent major transition from septic tank use to sewage treatment	sewer system overflows air pollution loss of water clarity due to sedimentation loss of scenic amenities revegetation	Bi-State Compact
THREE	1970 to present	commercial tourism year-round recreation	regional govt	completion and operation of major sewage treatment and export facilities	crowding traffic congestion air pollution loss of water clarity due to sedimentation loss of scenic amenities revegetation	TRPA NEPA EPA

Table V - 1: DOMINANT CHARACTERISTICS OF THE LAND DEVELOPMENT PROCESS: LAKE TAHOE REGION, MAJOR PERIODS 1950-1972

Source: staff research

SECTION VI

QUANTITATIVE ANALYSIS

This section describes the changes in the relationships between land use and wastewater management activities which occurred in the Lake Tahoe Basin from 1950 through 1972. The section is organized into two parts: a discussion of quantitative changes in discrete land use and wastewater management data and a statistical analysis of specific structural and causal relationships.

Summary of Findings

The following measures provide the best indicators of the magnitude of land use changes occurring during the period 1950-1972 in the Tahoe Basin.

--Permanent population has increased ten-fold from 2500 to over 25,000 persons.

--Peak day population has increased to an estimated 155,000 persons, an increase of over 400 percent.

--Subdivision lot approvals have outpaced housing construction approvals (building permits) by a ratio of 3:1, and the proportion of multiple housing units has increased dramatically since 1960.

Similar changes in sewerage facilities for the same time period are reflected in the following measures:

--All major plant capacity increases have occurred in the past five years; 72 percent of the existing Basin-wide treatment capacity has been provided since 1968.

--The percentage of total capacity utilized has only increased at an average rate of slightly over 2 percent over the past five years; the peak month average daily flow is currently less than 50 percent of the total capacity.

The most important findings derived from statistical analysis of land use and wastewater interrelationships may be summarized as follows. Substantial differences are apparent between the North and South lake shores.

--Treatment plant expansions at the California North Shore were accompanied by a corresponding increase in multiple family and motel/hotel construction approvals; on the South Shore intensive recreation uses (skiing and gaming) accompanied plant expansion.

--Subdivision approvals at the California North Shore do not indicate a strong relationship with expansion of sewerage facilities; however, on the South Shore subdivision activity in the two-year period preceding facility expansion shows this strong relationship to the planned capacity increase. This suggests that land subdivision at the South Shore may have been stimulated by the anticipated provision of wastewater infrastructure.

--The number of acres per subdivision decreased significantly and the number of lots per acre doubled following major capacity increases for all facilities, with the exception of Incline Village. These dramatic increases in land use density show a strong correlation to the expansion of sewage infrastructure.

Quantitative Changes in Land Use and Wastewater Management

Quantification and measurement of changes in both the land use pattern and wastewater management activity are central to this section of the research. Table VI-1 utilizes the conceptual framework of land development influences postulated in Section IV (see Table IV-1) to organize the specific types of data required for quantitative analysis. The availability and quality of these data are key determinants in the scope and depth of analysis. (Note: levels one and two are not quantifiable and are therefore not included in this discussion.)

LEVEL	LAND USE MEASURES	WASTEWATER MANAGEMENT MEASURES
1) Philosophical (Values)	Social and Economic Values (ownership) Amenity Values	Public Health; Environmental quality
2) Statutory	Land Use Law/Policy Planning Law/Policy	Wastewater Management and Water Pollution Legislation and Policy
3) Conceptualized Development	General Plan Use Districts Private Sector Development Proposals	Feasibility Studies; Facility plans; Planned Service Area Expansions
4) Legally Committed Development	Zoning Subdivision Approvals Building Permits Assesses Value	Facility Capacities Service Area
5) Physical Development	Buildings/Structures Population Land Use Activities	Facility operation Water quality

Table VI - 1: MEASURES OF LAND DEVELOPMENT: LAND USE AND WASTEWATER MANAGEMENT

Measures of Land Use Development

Level 3 - Conceptualized and Planned Development

Public Sector Planning: Prior to the adoption of the TRPA Plan in 1972, county and city general plans were the official public documents indicating planned land uses. In 1969 these general plans were adopted in the aggregate by the TRPA as an official interim regional plan. These two points in time, 1969 and 1972, provide the only basinwide measures of planned land use. Unfortunately the individual counties and the City of South Lake Tahoe did not systematically review, update and record changes in their General Plans, thus no quantitative record of public planning is available for the entire study period.

LAND USE CATEGORIES	PLACER COUNTY			EL DORADO COUNTY			DOUGLAS COUNTY			WASHOE COUNTY			TAHOE BASIN		
	INTERIM PLAN	TRPA PLAN	CHANGE	INTERIM PLAN	TRPA PLAN	CHANGE	INTERIM PLAN	TRPA PLAN	CHANGE	INTERIM PLAN	TRPA PLAN	CHANGE	INTERIM PLAN	TRPA PLAN	CHANGE
RURAL ESTATE	11,090	210	-12,650	20	0	-20	0	60	-1,240	0	300	-840	11,110	570	-14,750
RESID ESTATE OVER 1	1,770			0			1,300			1,140			4,210		
LOW RESID. 1-3 DU/AC	8,190	5,960	-1,230	11,750	7,680	-4,070	1,830	1,330	-500	2,650	2,190	-460	24,420	18,160	-6,260
MED RESID. 4-8 DU/AC	230	370	+140	390	810	+420	850	240	-610	160	250	+90	1,630	1,670	-40
HI RESID 8-15 DU/AC	490	330	-160	630	1,120	+490	500	610	+110	360	210	-150	1,980	2,270	+290
TOURIST COMMERCIAL	100	70	-30	980	880	-100	520	270	-250	230	120	-110	1,830	1,340	-490
LIMITED OR LOCAL COMM	340	400	-490	110	940	+410	60	130	-70	160	260	-80	670	1,730	-230
GENERAL COMMERCIAL	550			420			140			180			1,290		
SERVICE INDUSTRY	40	230	+190	430	530	+100	110	70	-40	0	80	+80	580	910	+330
COUNTY TOTALS	22,800	8,570	-14,230	14,730	11,960	-2,770	5,310	2,710	-2,600	4,880	3,410	1,470	47,720	26,650	-21,070
PERCENT REDUCTION			62.4%			18.8%			49.0%			30.1%			44.2%

Table VI - 2: ACREAGE COMPARISON OF LAND USE CATEGORIES INDICATED ON INTERIM (COMPILATION OF COUNTIES) PLAN AND TRPA PLAN

Source: TRPA General Plan and Interim Plan as tallied from UCSC Tahoe Data Bank
(There is some discrepancy between TRPA figures as recorded here and the TRPA General Plan due to the 10-acre-grid Data Bank scale)

Table VI-2 compares the acreages of specific land uses indicated on the county and city general plans in 1969 (TRPA interim plan) and the TRPA plan in 1972. Changes in use-district acreages are also included, showing the major reduction in planned use acreage resulting from adoption of the TRPA Plan. Basinwide 22,000 acres (approximately 34 miles) were removed from planned uses under the TRPA plan. This reduction reflected an overall "down-planning" of approximately 46 percent.

Private Sector Planning: No quantitative data were located which indicated the magnitude of private sector planning and development undertaken in the Tahoe Basin. The Boise Cascade Incline Village development in the early 1960's was privately planned and subsequently adopted as the public planning document. This Incline Village plan includes all but a small fraction of the land planned for development in the Washoe County portion of the Tahoe Basin.

Fibreboard Corporation and Trimont Land Co., planned major development in Placer County, however the proposals have not been realized, apparently due to the adoption of the TRPA Plan.

In El Dorado County the Tahoe Paradise development has had 52 individual subdivisions approved, indicating a substantial amount of private planning, although apparently no formal plan presented publicly, in contrast with the Boise Cascade.

Level 4 - Legally Committed Development

Zoning, subdivision approvals, issuance of building permits and assessed value are the principle sources for data which indicate a legal approval or commitment to land use and development by a public authority.

Zoning: The history of zoning in the Tahoe Basin is similar to that of public planning--there are very limited records with no systematic set of accounts to document changes. It is reasonable to conclude that zoning practices reflected the prevailing planning practices, exercising only minimal regulation and control of private development. Preliminary staff research indicates that documented zoning changes have increased land use densities with only limited downzoning in Douglas and Placer Counties occurring since 1969.

Subdivision: The most consistent data expressing legally committed development is the number of lots approved through the land subdivision process. The total number of subdivided lots has increased from 17,754 in 1950 to 49,334 in 1970, an increase of 181% in twenty years (Table VI-3).

YEAR	EL DORADO	PLACER	WASHOE	DOUGLAS	TOTAL/YR	AVERAGE/YR
pre-1950	NA	NA	NA	NA	17554	NA
1951	292	0	NA	0	292	97
1952	455	10	NA	15	480	160
1953	542	39	NA	30	611	204
1954	520	42	NA	0	562	187
1955	511	229	NA	268	1008	336
1956	511	33	NA	33	577	192
1957	1565	84	NA	368	2017	672
1958	565	44	NA	114	723	241
1959	1858	482	NA	158	2498	833
1960	1944	547	84	178	2753	688
1961	265	168	443	211	1087	272
1962	368	140	273	51	832	208
1963	472	576	569	48	1665	416
1964	598	221	41	45	905	226
1965	1435	611	725	206	2977	744
1966	402	383	0	128	913	228
1967	1526	112	0	0	1638	410
1968	1438	64	1540	420	3462	866
1969	1152	224	2686	72	4134	1034
1970	510	563	1719	73	2865	671
1971	1951	826	816	720	4323	1081
1951-71	18890	5398	8896	3138	36322	
TOTAL					53876	

Table VI - 3: NUMBER OF SUBDIVISION LOTS APPROVED FOR LAKE TAHOE BASIN BY COUNTY 1950- 1971

Source: Tahoe Regional Planning Agency 1"=400' Base Maps Oct. 1971 - Data compiled by author for UC Santa Cruz Tahoe Data Bank for 1950-1967; Regional Housing Element Update - TRPA/Economics Research Associates 1972 for 1968-1971

The percentage increase in subdivided lots varies considerably among the four counties as does the yearly variation within each county. It is interesting to note that subdivision approvals have consistently been three times greater than the number of single family housing units constructed.

Building permits: Nearly 20,000 building permits were issued for housing units in the decade of the sixties in the Tahoe Basin (Table VI-4).

	NUMBER OF UNITS			
COUNTY	SINGLE FAMILY	MULTIPLES	HOTELS/ MOTELS	TOTAL
El Dorado [1]	4269	2037	1815	8121
Placer	1908 [3]	1028	2016 [2]	4952
Washoe	2349	1409	921	4679
Douglas	522	570	844	1936
TOTAL	9048	5044	5596	19688

Table VI - 4: BUILDING PERMITS ISSUED FOR HOUSING UNITS -- LAKE TAHOE BASIN, 1960-1970.

Source: Raymond M.F. Smith, Housing Study of the Lake Tahoe Basin

1. From 1960 to 1963 some multiple and hotel/motel permits did not record units; totals reflect author's estimates for these years.

2. Placer County, Population and Housing Study, 1970, Appendix C. Figure is total number of units built, not permits issued.

3. Includes 1970 permits hand-counted September, 1973.

Multiple units, hotels and motels, accounted for more than half of the building permits issued in the 1960's. In a period of only four years, 1967-1970, a total of 2,100 permits were issued for condominiums (Table VI-5). These projects required sewers since clustered high density uses could not be accommodated on septic tanks.

LAKE TAHOE BASIN					
YEAR	EL DORADO	PLACER	DOUGLAS	WASHOE	TOTAL
1967	29	35	18	57	139
1968	11	64	25	162	262
1969	76	302	4	181	563
1970	109	507	70	450	1136
TOTAL	225	908	117	850	2100

Table VI - 5: BUILDING PERMITS ISSUED FOR CONDOMINIUM UNITS -- LAKE TAHOE BASIN 1967-70

Source: County Building Departments and Economic Research Associates; reported in Regional Housing Element Update, 1972.

This increase in building activity associated with condominiums and other high density units mirrors national and California trends, and may not be attributed solely to the availability of sewage capacity needed to serve such developments. Nationwide the construction of multiple units has increased from 22% of all housing starts in 1960 to 43% in 1970 (Table VI-6), an average of 35% for the ten year period. During the same period multiple unit permits issued in the Tahoe Basin also accounted for 35% of total permits issued.

YEAR	SINGLE FAMILY	MULTIPLE	TOTAL	MULTIPLE/TOTAL
1960	1008	287	1295	22%
1961	988	376	1364	28%
1962	996	496	1492	33%
1963	1022	619	1641	38%
1964	970	559	1529	37%
1965	964	509	1473	35%
1966	779	387	1165	33%
1967	844	448	1292	35%
1968	900	608	1508	40%
1969	811	656	1467	45%
1970	813	621	1434	43%

Table VI - 6: U.S. HOUSING STARTS 1960-1970 (Thousands of Units)

Source: U.S. Census of Housing, 1970

Assessed Valuation: Assessed value is a defacto indicator of the interaction between legal commitment and actual physical development. It is categorized here as a legal commitment since the basis of property taxes includes prevailing market conditions which are influenced in part by zoning and land subdivision as well as the improvements and income generated on the individual parcels.

Table VI-7 shows the assessed value of Tahoe Basin lands, including rates of increase within the four counties containing urban development.

Increases between 1960 and 1970 show rapid growth rates indicating an urbanization process, especially in the Nevada Counties.

YEAR	EL DORADO COUNTY		PLACER COUNTY[1]		DOUGLAS COUNTY		WASHOE COUNTY	
	DOLLARS	%Δ from 1960	DOLLARS	%Δ from 1960	DOLLARS	%Δ from 1960	DOLLARS	%Δ from 1960
1950	NA		8701000		NA			
1955	14393000[2]		13827000					
1960	39374000		23383000		6573000		3513000	
1965	73425000	86%	41162000	76%	21440000	226%	17331000	393%
1970	97450000	147%	83818000	258%	48694000	641%	59522000	1594%

Table VI - 7: ASSESSED VALUATION-LAKE TAHOE BASIN 1950-1970
(Percentages are based on growth since 1960)

Sources: Environmental Information Report, Tahoe Palace, (Smith, 1973)

1. Greater North Tahoe Chamber of Commerce
2. Estimate of El Dorado County Assessor

Level 5 - Physical Development

Population: The permanent population of the Tahoe Basin has increased tenfold in the past 22 years, from 2,500 residents in 1950 to an estimated 28,500 in 1972. The peak summer weekend population has climbed from an estimated 31,000 in 1950 to an estimate of 155,000 in 1970 (although estimates range from 98,000 (Walters Eng. 1973) to 247,000 (Smith 1971).) Table VI - 8 compares permanent, seasonal and peak day populations for 1950, 1960 and 1970.

Year	Permanent	%Δ *	Seasonal	%Δ	Peak	%Δ
1950	2,500[1]	--	24,000[2]	--	31,600[1]	--
1960	12,461	398%	38,700	61%	93,700[3]	197%
1970	25,892	935%	67,255	180%	155,000[4]	391%

Table VI - 8 : POPULATION ESTIMATES--LAKE TAHOE BASIN, 1950-1970
(% change calculated from 1950)

Source: Economic Research Associates and U.S. Census 1960, 1970

[1] South Lake Tahoe Chamber of Commerce, "Miscellaneous Data," 1972

[2] California Division of Water Resources, Report on Use of Water, June 1949 (Figure is maximum peak date, California side only, 1948)

[3] Real Estate Research Corp., Economic Base Study, 1961

[4] Eckbo, Deans, Austin and Williams, "Tahoe Population Estimates and Projections" (for TRPA), 1973

Housing: Housing and recreation activity reflect this rapid increase in population. The basin housing stock has more than doubled since 1960 (Table VI - 9). Washoe County, which is dominated by the major Incline Village development, has shown a spectacular increase. Each of the other counties has shown a substantial gain.

COUNTY	1960	1970	% Change
EL DORADO	5939	11305	90%
PLACER	2907	5915	104%
DOUGLAS	1045	2018	93%
WASHOE	148	1814	1126%
TOTAL	10039	21052	110%

Table VI - 9: TOTAL HOUSING UNITS, LAKE TAHOE BASIN 1960 and 1970

Source: Regional Housing Element Update, 1972.

N.B. 1970 total is greater than that of the field check (Table VI-10). Such discrepancies provide an example of the poor quality of data.

A summary of existing housing units, including motels, hotels and trailers is presented in Table VI - 10. Single family dwellings, including mobile homes, are now less than half of the total number of units. This fact, coupled with the increased percentages of multiple units built over the last decade provides evidence of a move toward greater densities in the residential land use pattern. This trend is indicative of a rapidly urbanizing area and marks a significant departure from the second home mountain resort Tahoe community of the 1950's. The South Shore counties contain twice the number of housing units as the North Shore counties.

	SINGLE FAMILY	MULTIPLE	HOTEL/ MOTEL	TRAILERS	TOTAL	
EL DORADO	8558	3476	6358	498	18690	South Shore 22199
[SOUTH LAKE TAHOE][1]	[5270]	[2984]		[265]	[8519]	
DOUGLAS	1167	618	1291	233	3174	
PLACER	4071	921	2769	252	8013	North Shore 11055
WASHOE	1024	1123	825	70	3042	
TOTAL	14820	6138	11243	1053	33254	
	20958					

TABLE VI - 10: DWELLING UNITS (LAKE TAHOE BASIN FIELD CHECK APRIL 1971)

Source: (Smith 1971)

[1] U.S. Housing Census, 1970.

Recreation Activity: Gaming revenues, skier days, and traffic volume are the best measures of recreation and tourism activity in the Tahoe Basin as only limited data exist on summer outdoor recreation activities.

Legalized gaming was established in the Tahoe Basin in 1955. The yearly increase in gaming has had a profound impact on the local economy. Table VI - 11 shows total yearly gaming revenues in Douglas and Washoe Counties. The Washoe County figures hide the extremely rapid growth within the Tahoe Basin due to the magnitude of the gaming industry in Reno-Sparks. In contrast, nearly all the gaming activity in Douglas County occurs within the Basin.

YEAR	DOUGLAS COUNTY		WASHOE COUNTY	
	Revenues (dollars)	%Change from 1956	Revenues (dollars)	%Change from 1956
1956	5,000,000		31,000,000	
1957	8,000,000	60	38,000,000	23
1958	12,000,000	140	40,000,000	29
1959	17,000,000	240	46,000,000	47
1960	23,000,000	360	54,000,000	74
1961	27,000,000	440	57,000,000	81
1962	32,000,000	540	60,000,000	94
1963	37,000,000	640	62,000,000	100
1964	41,000,000	720	71,000,000	129
1965	43,000,000	760	76,000,000	145
1966	52,000,000	940	84,000,000	171
1967	57,000,000	1040	88,000,000	184
1968	57,000,000	1040	89,000,000	190
1969	61,000,000	1120	95,000,000	206
1970	67,000,000	1240	107,000,000	245
1971	73,000,000	1360	120,000,000	287
1972	83,000,000	1560	134,000,000	300

Table VI - 11: GAMING REVENUES--NEVADA COUNTIES WITH URBAN AREAS IN LAKE TAHOE BASIN 1956-72. (Revenues from Reno and Sparks included in Washoe County figures)

Source: Nevada Gaming Commission

The decade of the 1960's was marked with a dramatic increase in the growth of skiing in the Lake Tahoe region. The north shore area experienced a five-fold increase in the number of skier days between 1960 and 1970, with a three-fold increase at south shore ski areas (Table VI - 12).

YEAR	NORTH SHORE		SOUTH SHORE	
	SKIER DAYS	% change from 1960	SKIER DAYS	% change from 1960
1960	140,000		110,000	
1961	170,000	21%	120,000	9%
1962	200,000	43%	130,000	18%
1963	230,000	64%	140,000	27%
1964	260,000	86%	150,000	36%
1965	300,000	114%	160,000	45%
1966	336,000	140%	175,000	59%
1967	605,000	332%	230,000	109%
1968	641,000	358%	230,000	109%
1969	702,000	401%	340,000	209%
1970	701,000	401%	302,000	175%
1971	740,000	429%	333,000	203%
1972	785,000	461%	364,000	231%

Table VI - 12: SKIER DAYS LAKE TAHOE BASIN 1960-72

Source: U.S. Forest Service, North Lake Tahoe Chamber of Commerce and Economic Research Associates.

Annual traffic census figures from the California and Nevada highway departments provide an excellent measure of the increase in demand for the Tahoe Basin Recreation amenities. Three major highways provide access to the basin: Highway 50 and Highway 89 in California and Highway 50 in Nevada. The increases in traffic volume on these highways are shown in Table VI - 13. Highway 50 shows a steady increase in both California and Nevada and clearly handles the major portion of vehicular traffic. The traffic on Highway 89 during the years preceding and immediately following the 1960 Olympic Games (1957-1961) dropped off sharply in 1962 and 1963 and has failed to reach previous levels in spite of the conversion of old U.S. route 40 to freeway standards (now Interstate 80). (See Figure V - 1 for location of highway access to the Lake Tahoe Basin.)

YEAR	HIGHWAY-50 EL DORADO CO.		HIGHWAY 89-PLACER CO.		HIGHWAY 50-CARSON CO.	
	VEHICLES	% change from 1950	VEHICLES	% change from 1950	VEHICLES	% change from 1950
1950	2543		2332		465	
1951	3053	20%	1800	-23%	512	10%
1952	3154	24%	2508	8%	592	27%
1953	3745	47%	2056	-12%	751	62%
1954	4311	70%	3444	48%	787	69%
1955	4551	79%	3430	47%	913	96%
1956	5556	118%	3841	65%	978	110%
1957	6417	152%	4414	89%	1109	138%
1958	7388	191%	4448	91%	1388	198%
1959	7933	212%	4480	92%	1595	243%
1960	9491	273%	4455	91%	1620	248%
1961	8650	240%	4000	72%	1664	258%
1962	5950	134%	2900	24%	1723	271%
1963	9550	276%	1800	-23%	1874	303%
1964	8450	232%	1900	-19%	2013	333%
1965	10350	307%	2150	-8%	2183	369%
1966	10600 [1]	317%	2250	-4%	2435	424%
1967	10300	305%	2375	2%	2244	383%
1968	10000	293%	2400	3%	2317	398%
1969	10500	313%	2750	18%	2307	396%
1970	10250	303%	3100	33%	2583	455%
1971	11050	335%	3350	44%	2726	496%
1972	12150	378%	3750	61%	2983	542%

Table VI - 13: MOTOR VEHICLES ENTERING TAHOE BASIN (AVERAGE DAILY COUNT ÷ 2) 1950-1972

Source: Annual Traffic Census, Calif. Division of Highways and Nevada Department of Highways

[1] Authors interpolation

Measures of Wastewater Management Activity

Level 3 -- Conceptualized Development

Sewerage facility feasibility studies are the main source of data for this level. Most studies were conducted by consulting engineering firms since the special districts had no in-house engineers. These studies generally included three elements: determination of system sizing, location of treatment plants and lines and financing of facilities.

Both new and expanded treatment plants have been oversized since 1968 especially those in Douglas County and Incline Village--see Table VI - 14. This was apparently due to the magnitude of the population projections used by consulting engineers to determine potential plant

YEAR	STPUD			DCSID #1			IVGID			TCPUD [2]			NTPUD [2]		
	FLOW	CAPACITY	PERCENT CAPACITY UTILIZED	FLOW	CAPACITY	PERCENT CAPACITY UTILIZED	FLOW	CAPACITY	PERCENT CAPACITY UTILIZED	FLOW	CAPACITY	PERCENT CAPACITY UTILIZED	FLOW	CAPACITY	PERCENT CAPACITY UTILIZED
1962	1,300,000	2,500,000	52	(300,000)	300,000[1]	100	NA	700,000		NA	250,000		NA	800,000	
1963	1,800,000	2,500,000	72	(350,000)	300,000	117	NA	700,000		NA	250,000		NA	800,000	
1964	2,000,000	2,500,000	80	(445,000)	300,000	148	NA	700,000		NA	250,000		NA	800,000	
1965	2,600,000	2,500,000	104	(521,000)	300,000	173	NA	700,000		170,000	250,000	68	958,000	800,000	120
1966	2,500,000	2,500,000	100	(568,000)	300,000	190	NA	700,000		183,000	250,000	73	565,000	800,000	71
1967	2,900,000	2,500,000	116	(587,000)	300,000	196	250,000	700,000	36	361,000	250,000	144	987,000	800,000	123
1968	2,600,000	7,500,000	35	582,000	3,000,000	19	439,000	700,000	63	237,000	250,000	95	555,000	800,000	69
1969	2,600,000	7,500,000	35	590,000	3,000,000	20	325,000	700,000	46	325,000	700,000	46	1,203,000	800,000	150
1970	3,000,000	7,500,000	40	600,000	3,000,000	20	433,000	700,000	62	396,000	1,444,000	27	667,000	1,656,000	40
1971	3,330,000	7,500,000	44	620,000	3,000,000	21	588,000	3,000,000	20	603,000	1,444,000	42	1,560,000	1,656,000	94
1972	3,500,000	7,500,000	47	650,000	3,000,000	22	NA	3,000,000		823,000	1,444,000	57	1,091,000	1,656,000	66
%Δ	169%	200%		117%	900%		135%	329%		384%	478%		14%	107%	

Table VI - 14: AVERAGE DAILY PEAK MONTH SEWAGE FLOWS AND PLANT CAPACITIES (GAL./DAY) 1950-1972

Source: Sewerage District Offices
Underlined figures depict situations where daily capacity was less than average daily flows during the peak month.
% is based on first year in each district for which figures were available

1. This capacity figure is actually allotment in STPUD plant until 1968. Flows 1962-67 for DCSID #1 are recorded also in STPUD, 1962-67.

2. Joint treatment plant for TCPUD & NTPUD began operating in 1970. Capacities figures have been allotted by agreement between these districts.

flows. Ultimate peak summer population projections which have been used for facility sizing range from 200,000 to 680,000 (see Figure A of Appendix C, Population Projections). These projections were based on very limited data covering very few years. For example, a 1959 report partly based facility sizes on a "greatly accelerated rate of growth (which) began in 1955 . . . the presently apparent trend is likely to continue for a good many years." (Brown and Caldwell, 1959, p. 33)

In addition to the creation of instant trends, engineering firms tended to borrow their projections from other studies rather than develop their own (see Appendix C for several examples). The paucity of time-series data is partly responsible for compounded errors. Independent research, however, could have limited the perpetuation of misinformation and inaccurate projections.

Conceptualized development of properly sized facilities has also been hindered by the tremendous disparity between peak loads and average loads on treatment systems. This condition is primarily a function of tourism in the Tahoe Basin.

Another measure of conceptualized development is the planned expansion of sewerage district service areas. Table VI - 15 shows present service district areas and major annexations. These service areas are compared with the maximum permitted urban uses indicated in county general land use plans (TRPA Interim Plan) and also with the current TRPA Plan.

DISTRICT	FORMATION DATE	SERVICE DISTRICT AREA (ACRES)	MAJOR ANNEXATIONS (ACRES)	ORIGINAL TREATMENT PLANT CAPACITY (GALLONS/DAY)	EXISTING TREATMENT PLANT CAPACITY (GALLONS/DAY)	MAXIMUM RESIDENTIAL AND COMMERCIAL DEVELOPMENT (ACRES)			
						INTERIM PLAN 1	TRPA PLAN 2	CHANGE	PERCENT CHANGE
Tahoe City PUD	1938	17,730	1010 (1966) 4[illegible]0 (1967) 3170 (1968) 6500 (1970) 2080 (1971)	250,000 (1953)	3,100,000 (1970)	10,620	5,300	-5,320	-50.1%
North Tahoe PUD	1949	4,300	2270 (1966)	800,000 (1954)		3,120	2,550	-570	-18.3%
Incline Village GID	1961	6,910		700,000 (1962)	3,000,000 (1971)	4,240	3,010	-1,230	-29.0%
Washoe SID #1	1966	60				60	50	-10	-16.7%
Crystal Bay GID	1972	160				140	0	-140	-100.0%
South Tahoe PUD	1950	21,200	4450 (1958) 1640 (1965) 1480 (1967) 8390 (1972)	200,000 (1952) 2,500,000 (1960)	7,500,000 (1968)	11,650	10,540	-1,110	- 9.5%
Douglas Co. SID #1	1953	300		300,000 (allotment in STPUD Plant)	3,000,000 (1968)	930	580	-350	-37.6%
Kingsbury	1964	4,000				1,610	510	-1,120	-69.6%
Round Hill	1964	750				540	420	-120	-22.2%
Tahoe Douglas	1969	3,400				1,910	1,030	-880	-46.1%
Elk Point	1969	100				50	70	+20	+40%

Table VI - 15: SUMMARY OF SEWERAGE DISTRICT DEVELOPMENT

Source: Sewerage District Offices

1. TRPA INTERIM PLAN: Does not include recreation or open space land use categories

2. TRPA PLAN: Does not include development reserve or recreation land use categories

Level 4 -- Legally Committed Development

Data at this level include the rated capacities of treatment plants and the costs of constructing and expanding such facilities. The pattern of added sewage capacities in the Basin between 1950 and 1970 is very clear (Figure VI - 1). Small plants were built at both the north and south shores in the early 1950's. The South Lake Tahoe plant, where the population concentration was greatest, increased capacity elevenfold in 1960. By the late 1960's all plants were operating near capacity and three new plants and one large plant expansion occurred between 1968 and 1971. The decision to export all sewage from the basin and the concurrent availability of federal water pollution control grants was undoubtedly a major impetus for expansion during this period.

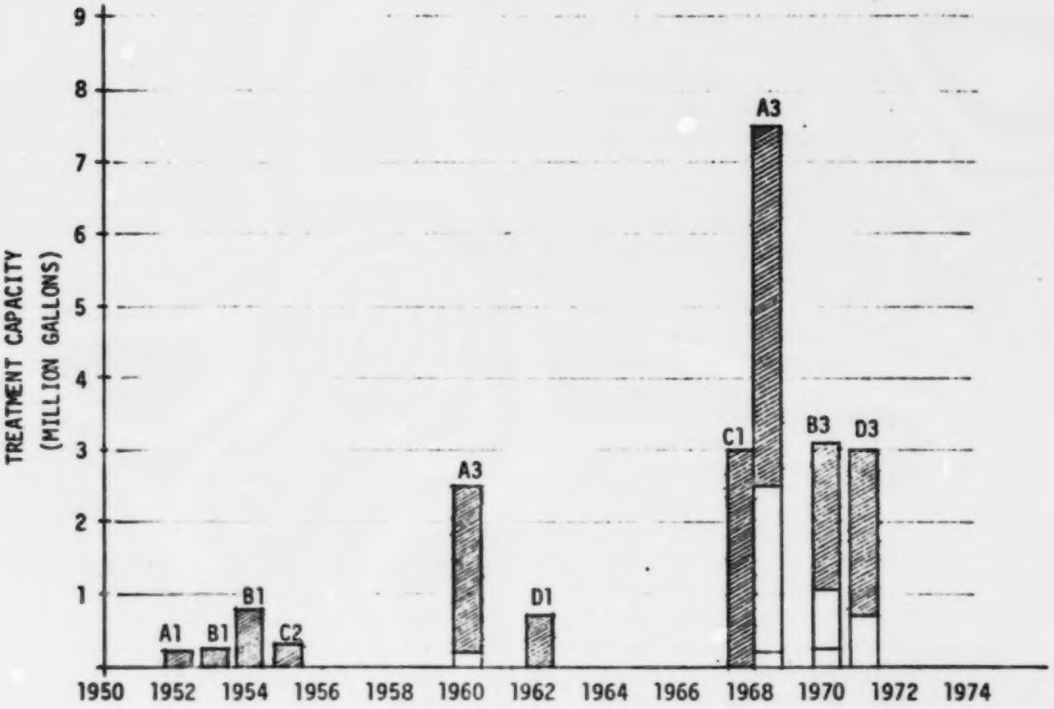


Figure VI - 1: TIMING OF WASTEWATER MANAGEMENT FACILITY PROVISION AND EXPANSION

KEY:
(A) EL DORADO COUNTY
(B) PLACER COUNTY
(C) DOUGLAS COUNTY
(D) WASHOE COUNTY

(1) INITIAL PLANT CONSTRUCTION
(2) CAPACITY ALLOCATION FROM OTHER DISTRICT
(3) CAPACITY ADDED

Developing useful data on costs has proved very difficult. Estimates of total wastewater treatment costs have been as high as $82,000,000 (U.S. Senate 1972a, p. 11) in the Lake Tahoe Basin. Most of these expenditures have been made since 1966 when a bi-state policy mandated sewering of all development and the export of all effluent. Federal grants which have totaled about $16,200,000 have financed treatment plants, interceptor lines and export facilities.

A quantitative analysis of these costs was not possible. Cost reporting has been very unreliable both within and among sewerage districts, and sets of federal grant allocation data collected for this study have also proved incomplete or inconsistent.

Level 5 - Physical Development

Sewage flows are the best available measure of actual utilization of wastewater treatment facilities.

Average daily peak month flows have shown large increases as would be expected in an area experiencing rapid growth. The increases have been steady and consistent among districts with the exception of the North Tahoe PUD. At North Tahoe the peak flows have been in March or April as contrasted to August for the Basin districts as a whole. Snow melt infiltration into the lines may have contributed substantially to these peak flows (Walters, 1973).

Treatment plant capacities underlined in Table VI - 14 indicate years in which peak month average daily flows exceeded rated capacities. This often resulted in plant overflows. In each case an expanded treatment capacity was added within several years. Federal grants for treatment plants, interceptor lines and export pumps and lines were readily available in the mid-sixties to make such expansion economically feasible (U.S. Senate, 1972a).

Existing equivalent population figures can be derived by dividing wastewater flows by an assumed number of gallons of wastewater each person would contribute (Table VI - 16). Estimates of this per capita factor have varied considerably. The first column of Table VI - 16 provides a range of factors used in various wastewater feasibility studies. The calculated 1970 seasonal population of 67,900 using a factor of 75 gallons per capita per day is consistent with other estimates (see Table VI - 8). The peak population equivalent as derived in the table is considerably lower than other estimates which range from 98,885 (Walters Engineering, 1973) to 248,000 (Ray Smith, 1971). These calculations do account for continued use of septic tanks (perhaps an additional 5,000 persons). In addition, if infiltration of snow melt and ground water are included in the calculations, effective treatment flow would also decrease, thus lowering population equivalent figures by as much as 5,000 to 10,000 persons.

GALLONS/ CAPITA/ DAY	AVERAGE DAILY FLOW PEAK MONTH	ESTIMATED SEASONAL POPULATIONS	PEAK DAY[3]	ESTIMATED POPULATION
75[1]	5,096,000	67,900	6,440,000	85,900
100	5,096,000	50,960	6,440,000	64,400
140[2]	5,096,000	36,400	6,440,000	46,000

Table VI - 16: CALCULATED PEAK POPULATION ASSUMING VARIOUS PER CAPITA FLOWS, LAKE TAHOE BASIN, 1970

Source: Sewerage District Offices
1. Crystal Bay Dev. Co. Incline Village
2. Walters Engineering, 1973
3. Report on L.T. Region Wastewater Collection, Treatment and Disposal, prepared for TRPA, 1971; These figures are called Historical Maximum daily flow.

This analysis is of limited value without a method to discount the per capita factor for day users and overnight visitors. Such an approach is beyond the scope of this research, but the need for a more sophisticated factor points out the difficulties inherent in determining the composition of populations in recreation areas.

Relationships Beteen Land Use and Wastewater Management Activity

The purpose of this part of Section VI is to describe the structural and causal relationships between land use and wastewater management data as determined through statistical methods. Since the research is specifically concerned with the changes and relationships among data over a 23-year period, time series data were requisite for statistical analysis.

Extensive sets of data were compiled from primary and secondary sources to provide a range of measures of various pertinent activities, including land use changes, wastewater management, economic indicators, other infrastructure, and major exogenous factors. These data sets were then prepared for computer processing. A compilation of data items is listed in Appendix E.

Data characteristics

Variations in the magnitude and pattern of change in pertinent time-series data sets have shaped the selection of analytical methods. The data sets generally fall into four distinct categories as shown in Table VI - 17. This table graphically illustrates the pattern of change common to each category by plotting cumulative data totals over time.

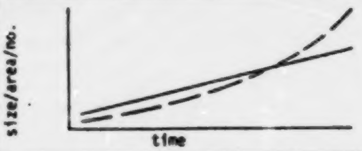
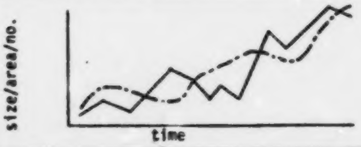
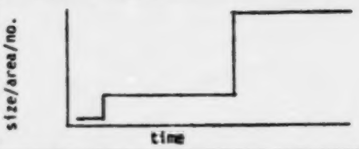
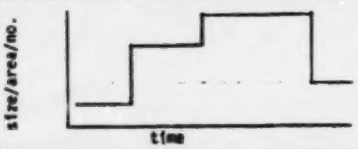
CATEGORY	CHARACTERISTICS OF TEMPORAL CHANGE	CHARACTERISTIC PLOT OF DATA	DATA
1	steady linear or exponential increase		population sewage flows gaming revenues
2	uneven or variable linear or exponential increase		subdivision approvals building permits traffic volume skiier days assessed valuation
3	stepped, irregular increases		treatment plant capacity wastewater service district area
4	stepped, irregular increase and decrease		land use plan use-acreages population holding capacity of land use plans

Table VI - 17: DATA CLASSIFICATION SHOWING CHARACTERISTICS OF LONGITUDINAL CHANGE

Source: staff

These patterns are not unique to the Tahoe case, but appear to be general properties of land use and infrastructure system data. The stepped-type pattern (categories 3 and 4) characteristic of infrastructure activity particularly limits comparisons with data sets in other categories. T-Tests proved to be the best method for the analysis of stepped-type data.

Data Limitations: Data limitations were also an influential factor in the selection of analytical methods. The following limitations were determined:

1. The data observations generally cover a period of dramatic and irregular change.

2. Numerous data gaps exist in spite of a thorough and systematic reconnaissance of both primary and secondary sources.

3. The quality of data is poor in many cases. Numerous contradictions exist among recorded data. Accounting systems vary among reporting units. Some units are not congruent with the study area.

4. The major expansions of sewerage capacity have all occurred within the last two to five years. Land use change following these expansions can only be analyzed for a very short period of time.

5. The period of time surrounding the creation of TRPA may have been one of anticipation and adjustment by land developers. If so, data from this period would not reflect typical patterns of land development, at least in its relationship to wastewater system activity.

Statistical Analysis

Units of Observation: The Tahoe Basin provides numerous possibilities for data aggregation: states, counties, wastewater management districts, north and south lake shore economies (Symonds, 1970). Five criteria were considered in determining the appropriate level of aggregation for analysis:

1. total number of discrete data available;
2. total number of discrete data capable of disaggregation;
3. sufficient available data for both land use and wastewater management;
4. data represented within each of the three levels of land development influence (i.e., planned, committed, actual);
5. sufficient number of time-series observations for statistical significance.

County level data could best provide for a reasonable range of analysis, especially in the area of land use data. El Dorado, Washoe and Douglas Counties each contain a large wastewater management district; Placer County contains two large districts. Furthermore, separate treatment plants and export systems now exist for each county.

Land development has varied dramatically among the four counties, adding another dimension to the analysis. Table VI - 18 compares pre-1950 development with development occurring during the period 1950-1970 and the development projected under the TRPA Plan.

	LAKE TAHOE BASIN							
	CALIFORNIA				NEVADA			
NORTH SHORE	PLACER CO.				WASHOE CO.			
	YEAR	ACRES	SQ. MILES	% INCREASE	YEAR	ACRES	SQ. MILES	% INCREASE
	PRE-1950[1]	3840	6.00	--------	PRE-1950	460	.72	--------
	1950-1970[1]	5910	9.23	54.0%	1950-1970	3490	5.45	659.0%
	1971-1990[2]	8570	13.39	45.0%	1971-1990	3410	5.33	0 %
SOUTH SHORE	EL DORADO CO.				DOUGLAS CO.			
	YEAR	ACRES	SQ. MILES	% INCREASE	YEAR	ACRES	SQ. MILES	% INCREASE
	PRE-1950	4830	7.55	--------	PRE-1950	940	1.46	--------
	1950-1970	10750	16.8	122.6%	1950-1970	2040	3.19	117.0%
	1971-1990	11960	18.7	11.3%	1971-1990	2710	4.23	32.8%

Table VI - 18: PAST AND EXISTING SUBDIVIDED LANDS AND PROJECTED LAND DEVELOPMENT: LAKE TAHOE BASIN

Note: Pre-1950 and 1950-1970 data are actual subdivided lands; 1971-1990 are lands indicated for development on the TRPA plan.

Sources: 1. Staff hand count June 1963 from 1"-4000' TRPA Base Maps 1971; calculated from UCSC Tahoe Data Bank

2. TRPA General Plan 1971; calculated from UCSC Tahoe Data Bank 1973.

On the basis of these factors it is reasonable, as well as practical, to select a county level of aggregation as the units for statistical analysis.

Prior to undertaking specific analysis, data were organized into six sets defined by the planned, permitted, and actual development levels as shown in Figure VI - 19.

LAND DEVELOPMENT LEVEL	VARIABLE A. LAND USE MEASURES	 B. WASTEWATER MANAGEMENT MEASURES
Conceptual Committment (Plans)	A-1. General Plan Use Districts Zoning Plans Population Projections	B-1. Feasibility Studies Facility Plans Population Projections Service Area Plans
Legal Committment (Permits, Approvals)	A-2. Subdivision Approvals	B-2. Annexations; Service Area Expansions Facility Grant
Physical Provision (Construction)	A-3. Housing Units Assessed Valuation Population--Permanent, Seasonal, Peak Traffic Volumes Skiier Days Gaming Revenues	B-3. Assessment Districts; Service Areas Sewerage Flows Customers Treatment Plant Capacity

Table VI - 19: DATA SETS FOR STATISTICAL ANALYSIS

Of primary interest is the strength and direction of influence between and among sets. A total of thirty possible direct relationships exist among the six sets (6!). Conceptually the influence levels indicate a time sequence; that is, level two would generally follow level one. However, a change in level two or three may produce a change in level one. For example, an increase in seasonal population (A-3) would directly increase sewage flows (B-3). The population projection (A-1, B-1) based on this seasonal increase would likely influence change in general plans and zoning (A-1); wastewater facility plans (B-1), subdivision activity (A-2) and service district annexations (B-2).

The necessary data sets include well over one-hundred variables counting discrete data for each county and sewerage district. Only thirty variables are defined by continuous time series data from 1950-1972, considerably limiting analysis of the twenty-three year period. Data for STPUD and El Dorado County provide the majority of complete time series data.

The analysis has been conducted using the Statistical Package for the Social Sciences (SPSS) Version 5. Statistical analyses including correlation, factor analysis, regression, and T-tests were employed to determine the nature and degree of relationships among selected data sets.

Findings

The following discussion of analytical techniques is presented in summary form; Appendix D, Statistical Analysis, provides a complete description of all statistical tests and results.

Correlation: Correlation coefficients indicate the strength of relationships between pairs of time series of data. The fifteen variables shown in Table VI - 20 were selected to provide measures of five development categories: land use, wastewater management, tourist activity, population, and market influence.

CATEGORY	VARIABLES			LAND DEVELOPMENT INFLUENCE LEVEL (FROM TABLE VI - 19)
	NO.	NAME	MEASURE	
1.LAND USE	1	SUBDIVISION APPROVALS	# LOTS	A-2
	2	BLDG PERMITS (SINGLE FAMILY RESIDENTIAL)	# PERMITS	A-3
	3	BLDG PERMITS (MULTI-FAMILY RESIDENTIAL)	# PERMITS	A-3
	4	ASSESSED VALUATION	DOLLARS	A-3
2 WASTEWATER MANAGEMENT	5	TREATMENT PLANT CAPACITY	GALLONS	B-2
	6	WASTEWATER SERVICE DISTRICT	ACRES	B-2
	7	WASTEWATER FLOWS (DAILY)	GALLONS	B-3
3.TOURIST ACTIVITY	8	TRAFFIC ENTERING BASIN	VEHICLES/DAY	A-3
	9	GROSS GAMING REVENUES	DOLLARS	A-3
	10	SKIER USE DAYS	PERSONS	A-3
4.POPULATION	11	TOTAL BASIN POPULATION.	PERSONS	A-3,B-3
	12	PERMANENT POPULATION (COUNTY PORTION OF BASIN)	PERSONS	A-3,B-3
	13	PROJECTED POPULATION (1980 PLAN)	PERSONS	A-1,B-1
5.MARKET INFLUENCES	14	PRIMARY MARKET	FAMILIES	----
	15	PRIME INTEREST RATE	PERCENT	----

Table VI - 20: DATA SET CATEGORIES AND VARIABLES FOR CORRELATION AND REGRESSION ANALYSIS

A matrix of correlation coefficients was computed for each data pair, resulting in one-hundred and five discrete coefficients for each county. The statistically significant correlations all indicate a positive relationship between variables. Although ninety-nine statistically significant coefficients were computed, the small sample size (i.e., number of years of observation) prohibited statistical differentiation of the relative strength among coefficients. The significant correlations indicate the data have a positive relationship of unknown strength. No other conclusion may be drawn from these results.

Factor Analysis: Factor analysis is a widely employed statistical method for aggregating data sets which exhibit common variation. By reducing a large number of related variables into factors, the researcher can use fewer measures in analysis without losing the contribution of individual data.

A number of factor matrices were computed for the fifteen data sets selected for correlation analysis. The resulting factors did not exhibit any logical structure and were inconclusive for application in further analysis (see Appendix D).

Regression: Stepwise multiple regression analysis determines which data, acting independently, best explain or predict the variation in specified dependent data. A dependent variable is first selected by the researcher and a "prediction equation" is then computed for specified independent variables. The regression computations rank the independent variables according to their strength in explaining change in the dependent variable. The step indicated by ranking at which an independent variable enters the regression equation measures its relative ability to explain the remaining variance in the dependent variable. An independent variable appearing in step-one indicates the strongest relationship to the dependent variable; step-two indicates next strongest, etc. Causality can be inferred if the independent variable clearly precedes the dependent variable in time.

Discrete measures of land use and wastewater management were selected as dependent variables for each of the land development influence levels, i.e., planning, legal commitment, and physical provision. A wide range of land use and wastewater measures were entered as independent variables and stepwise regression equations were computed. By comparing the ranking of independent variables in the regression equations to the sequence they normally follow in the development process (Table VI - 19) causality can be inferred.

Anticipation to treatment plant expansion was statistically tested by computing regression equations with the dependent variable treatment plant capacity hypothetically advanced by one and two years. Capacities were also hypothetically lagged by one and two years to provide a corresponding measure of the influence following increased capacity.

The following data sets were selected as dependent variables. Wastewater management activities selected were treatment plant capacity, service area, and treatment plant flows. Land use activities were limited to subdivision approvals and total building permits.

The following discussion summarizes the results of the computed regression equations.

Treatment Plant Capacity, El Dorado County: Five regression equations were computed for South Tahoe PUD plant capacity by hypothetically moving the dependent variable (capacity) from minus two years to plus two years from the date of plant expansion (Table VI - 21). The variables entering these time series comparisons would indicate anticipation of expansion (-2, -1 years) and response to expansion (+1, +2 years).

		PRE-EXPANSION		EXPANSION	POST-EXPANSION	
		-2 yrs	-1 yrs		+1 yr	+2 yrs
INDEPENDENT VARIABLES	STEP 1	Subdivision Approvals (.85)	Subdivision Approvals (.87)	Service District (.90)	Ski Days South Shore (.85)	Gaming Douglas Co. (.76)
	STEP 2	Ski Days South Shore (.97)	Building Permits (.95)	Subdivision Approvals (.93)	Permanent Population (.87)	Motel/Hotel Building Permits (.89)
	STEP 3		Ski Days South Shore (.98)	Gaming Douglas Co. (.92)	Gaming Douglas Co. (.92)	Service District (.91)
	STEP 4		Service District (.99)	Traffic Volume (.93)	Building Permits (.93)	Ski Days South Shore (.93)
	STEP 5					Permanent Population (.94)

Table VI - 21: REGRESSION ANALYSIS -- SOUTH TAHOE PUD TREATMENT PLANT CAPACITY (R^2 in parentheses)

Service district size was the step-one independent variable entering the equation in the year of capacity expansion (0 year). This could indicate an annexation program closely tied to plant expansion. In the two years preceding plant expansion (-2, -1 years), subdivision approvals entered the regression equations at step one. However, following plant expansion subdivision approvals fail to make any appreciable contribution.

Skier days and gross gaming revenues (Douglas County) are the step-one variables following plant expansion (+1, +2 years). On the basis of these results, two important observations should be made: a land speculation variable (subdivision approvals) dominates the pre-expansion equations; intensive recreational use variables (skiing and gaming) dominate the post-expansion equations. In El Dorado County the expansion of wastewater management facilities may in fact have stimulated subdivision activity prior to the opening of expanded plants, and stimulated intensive recreation following expansion.

Treatment Plant Capacity, Placer County: A distinctly different pattern emerges from a similar analysis of North Tahoe and Tahoe City PUD's plant expansions in Placer County (Table VI -22). In the years preceding plant expansion, single family building permits are the dominant land use variable, although in each case it is the second-step variable in the regression equation. Service area enters at the first step, indicating an expansion/capacity relationship similar to that of South Tahoe PUD.

		PRE-EXPANSION		EXPANSION	POST-EXPANSION	
		-2 yrs	-1 yr		+1 yr	+2 yrs
INDEPENDENT VARIABLES	STEP 1	Ski Days North Shore (.93)	Service Area (.83)	Multiple Building Permits (.93)	Multiple Building Permits (.91)	Multiple Building Permits (.69)
	STEP 2	Single Family Building Permits (.98)	Single Family Building Permits (.84)	Single Family Building Permits (.96)	Traffic Volume (.98)	Permanent Population (.80)
	STEP 3		Multiple Building Permits (.85)	Gaming Washoe Co. (.98)		Ski Days North Shore (.82)
	STEP 4		Permanent Population (.92)			
	STEP 5					

Table VI - 22: REGRESSION ANALYSIS -- NORTH TAHOE PUD AND TAHOE CITY PUD TREATMENT PLANT CAPACITY (R^2 in parentheses)

Multiple family and motel/hotel building permits are the first-step variable in the year of expansion and the two years following. This variable does not enter the -2 year equation; enters the -1 year equation at step three; but is the primary variable in the expansion, +1, and +2 equations. A clear pattern can be seen: plant capacity expansions in Placer County are accompanied by a corresponding increase in multiple and motel/hotel building permits.

Subdivision approvals do not enter the plant expansion equations for Placer County; as such it seems reasonable to conclude that land speculation (expressed through subdivision approvals) was not influenced by increased treatment plant capacities.

Wastewater Flows: Building permits constitute the only significant variable explaining the character of the dependent variable, treatment plant flows. Single family building permits at the north shore and total building permits at the south shore were found to be the best indicators of increased flows.

Subdivision Approvals: The following influences on the dependent variable, subdivision approvals, were determined. Gross gaming revenues (Douglas County) provide the initial regression variable in El Dorado County, followed by plant capacity. In Placer County the first step variable is permanent population with multiple and motel/ hotel building permits entering at step two.

El Dorado County subdivision activity appears to be stimulated by the south shore gaming industry perhaps through either direct economic activity or through high visitor days. Placer County subdivision activity may reflect demand expressed through growth in population and construction. This may indicate a stronger regulation of land use in Placer County in contrast with El Dorado County's apparent policy of supporting land speculation.

Building Permits and Wastewater Service Areas: No conclusive findings were determined in the regression equations computed for these variables.

T-Tests: The significance of the difference between two group averages, or means, can be tested by the Student's T-statistic. Any apparent difference must be subjected to this kind of testing since the variation within a group may be too large to allow inferences to be made about the accuracy of the group mean. This test can be extremely powerful in situations where the means are sufficiently disparate because a significant difference can be detected even with very small samples.

Although correlation and regression techniques can be used to determine the nature and strength of relationships among variables, the peculiar characteristics of wastewater infrastructure capacity (i.e., the stepped nature of capacity and the magnitude of capacity added) suggest a need for analysis of land use measures (subdivision approvals and building permits) preceding and following treatment plant expansion.

T-test statistics were computed for six land use variables using groups defined by periods preceding and following treatment plant expansions and periods when plants experienced flows very near the limits of their capacity. The six land use variables and the types of periods selected, including three hypothetical examples of T-test results are shown in Table VI - 23.

		GROUPS (YEARS)				
WASTEWATER MANAGEMENT DISTRICT ACTIVITY (WHERE APPLICABLE)		PRE-INITIAL PLANT	POST INITIAL PLANT	PRE-EXPANSION	OVER CAPACITY	POST MAJOR EXPANSION
LAND USE VARIABLE	BUILDING PERMIT SINGLE FAMILY	1_a	2_a			
	BUILDING PERMIT MULTI-FAMILY		1_b	1_b	1_b	2_b
	BUILDING PERMIT MULTI-FAMILY PLUS MOTEL/HOTEL					
	ACRES SUBDIVIDED					
	LOTS SUBDIVIDED					
	LOTS PER ACRE		1_c	1_c	2_c	

Table VI - 23: LAND USE VARIABLE FRAMEWORK FOR T-TEST GROUPS
Examples a, b, and c indicate organization of data into test groups. In example a, the two groups measure building permits immediately preceding and following provision of initial facilities. Example b groups multiple family building permits following initial plant provision and major plant expansion, and example c measures lots per acre between provision and expansion grouped into below and over capacity periods.

Statistically significant differences were found among eight pairs of test groups. An additional twelve pairs showed differences in the variables which were not statistically significant (n.s.), but which warrant inclusion in the discussion.

El Dorado County: Following the 1968 South Tahoe PUD plant expansion the average acreage of subdivisions dropped from a 37 acre mean in 1960-1967 to a 19 acre mean in 1968-1972 (Table VI - 24). Since no parallel reduction in the number of lots per subdivision accompanied this reduction in acreage, a large increase must have occurred in the average density of land use. The number of lots per acre actually increased from 2.6 (1960-1967) to 4.2 (1968-1972).

Period of Observation	Group 1		Group 2		Test Variable	Significance (P)	
	years	mean	years	mean		1 tail	2 tail
Group 1--Between original plant capacity and first plant capacity expansion Group 2--Between first plant capacity expansion and major plant capacity expansion	1951-1959	--	1960-1967	341	building permits SF		
		--		283	building permits MF		
		31		37	acres/subdivision		
		83		90	lots/subdivision		
		3.0		2.6	lots/acre		
Group 1--Between first plant capacity expansion and major plant capacity expansion Group 2--Following major plant capacity expansion	1960-1967	341	1968-1972	308	building permits SF		
		283		195	building permits MF		
		37		19	acres/subdivision	.005	.002
		90		78	lots/subdivision		
		2.6		4.2	lots/acre	.005	.003
Group 1--Between first plant capacity expansion and initial overcapacity year 1965 Group 2--Overcapacity years preceding major plant capacity expansion	1960-1964	378	1965-1967	280	building permits SF		
		213		399	building permits MF		
		40		32	acres/subdivision		
		90		78	lots/subdivision		
		2.3		2.8	lots/acre		

Table VI - 24: T-TEST RESULTS -- EL DORADO COUNTY (STPUD)

More specifically during that seven-year pre-expansion period, the number of lots per acre increased from 2.3 in 1960-1964 to 2.8 in 1965-1967 (n.s.); the latter being a period when the South Tahoe PUD treatment plant sometimes operated beyond the limits of its capacity (see Section VII,"County and State Response"). The expansion of treatment facilities (1960-1972) has been accompanied by a significant increase in the density (lots per acre) of subdivided property in El Dorado County.

The number of single family building permits dropped from an annual mean of 341 permits issued before the 1968 expansion to 308 permits issued yearly following the expansion (n.s.).

The pre-expansion period from 1960 to 1967 divided into two smaller periods; 1960-1964, when single family building permits averaged 377 annually and 1965-1967, when permits dropped sharply to a yearly mean of 280 (n.s.).

These differences in yearly means might be a reflection of a conscious effort on the part of local officials to curb building construction during periods when flows were very close to capacity. However, during the same time periods a composite of multiple family and motel/hotel units increased from an annual mean of 439 in 1960-1964 to 670 in 1965-1967 (n.s.).

The increase in the number of approvals of higher density units came at a time when overflows of the South Tahoe PUD facility were a highly visible problem and as such provides further evidence that local land use controls were not being exercised to maintain environmental quality in the face of growing water pollution concerns.

Douglas County: The amount of subdivision acreage approved annually has remained relatively constant in Douglas County over the period 1951-1967 (subdivision data observations are not available after 1968). The number of lots per subdivision increased significantly following the allocation of a portion of South Tahoe PUD plant capacity (post 1954) until the initial operation of the Douglas County plant in 1968. The number of lots per subdivision increased from a mean of 16 in 1951-1954 to 48 in 1955-1967, a 200% jump (Table VI - 25).

Period of Observation	Group 1		Group 2		Test Variable	Significance (P)	
	years	mean	years	mean		1 tail	2 tail
Group 1--Between original contract with STPUD and 1968 major plant capacity expansion Group 2--Following 1968 major plant capacity expansion	1955-1967	54	1968-1972	39	building permits SF	<.05	.06
		59		49	building permits MF		
		23		24	acres/subdivision		
		16		48	lots/subdivision	<.005	.001
		1.1		2.2	lots/acre	<.05	.094
Group 1--Between original contract with STPUD and initial overcapacity year 1963 Group 2--Overcapacity years preceding major plant capacity expansion	1955-1962	58	1963-1967	51	building permits SF		
		68		162	building permits MF		
		26		15	acres/subdivision		
		52		38	lots/subdivision		
		2.4		1.8	lots/acre		

Table VI - 25: T-TEST RESULTS -- DOUGLAS COUNTY (DCSID #1)

Average daily sewage flows peak month, often exceeded allocated capacity in the STPUD treatment plant during the period 1963-1967 (see Table VI - 14). The mean number of lots per subdivision dropped during this period to 38 from a mean of 52 during the period from 1955-1967 (n.s.). Unlike El Dorado County, the density declined from 2.4 lots per acre in the period 1955-1962, to 1.9 lots per acre in 1963-1967 (n.s.).

The number of single family building permits issued showed a significant decline, from a mean of 54 permits per year (1955-1967) to a mean of 39 permits per year (1968-1972). The mean number of multiple family (and motel/hotel) units followed a very different pattern. The mean of 68 units per year during 1955-1962 jumped to 162 units/year during the period 1965-1967. There was no increase in the mean number of multiple units from 1968-1972 (n.s.).

As in the case of El Dorado County, increases in multiple family and motel/hotel units occurred during the same period when sewage flows exceeded plant capacity in the six years preceding the expansion of the STPUD plant and the initial operation of the Douglas County plant.

Placer County: A significant reduction in the number of acres per subdivision is apparent in Placer County following the opening of a joint treatment plant in 1970 (Table VI - 26). The size of the average subdivision dropped off sharply from 25 acres (1964-1969) to 12 acres (1970-1972).

Period of Observation	Group 1		Group 2		Test Variable	Significance (P)	
	years	mean	years	mean		1 tail	2 tail
Group 1--Between original plant capacity and major plant capacity expansion in 1970 Group 2--Following 1970 major plant capacity expansion	1954-1969	53	1970-1972	182	building permits SF		
		47		287	building permits MF		
		25		12	acres/subdivision	.0005	.001
		59		58	lots/subdivision		
		2.3		4.8	lots/acre	.0005	.001
Group 1--Between original plant capacity and overcapacity years Group 2--Overcapacity years preceding 1969 major plant capacity expansion	1954-1964	160	1965-1969	186	building permits SF		
		4		90	building permits MF	<.05	.07
		23		27	acres/subdivision		
		52		75	lots/subdivision		
		2.3		2.4	lots/acre		
Group 1--Overcapacity years preceuing 1969 expansion Group 2--Following 1970 plant capacity expansion					building permits SF		
	1965-69	90	1970-72	959	building permits MF		
					building permits M/H		

Table VI - 26: T-TEST RESULTS -- PLACER COUNTY (NTPUD and TCPUD)
(SF=Single Family Residential; MF=Multiple Family Residential)

The annual mean number of lots per subdivision remained constant for these two time periods, although an appreciable increase is apparent in the years immediately preceding the 1970 plant opening when peak sewage flows were a great concern (see Section VII). During this time the mean number of lots per subdivision was 75, considerably higher than the mean of 52 from 1954-1964 (n.s.).

There was no corresponding increase in density (lots per acre) in the periods preceding 1970. A significant increase from a mean of

2.3 lots per acre (1954-1969) to 4.8 lots per acre (1970-1972) has occurred since 1970.

The mean number of single family building permits issued also shows a sizeable increase during the post-plant expansion period. The mean of 47 permits per year from 1954-1969 increased sixfold to 287 per year in 1970-1972 (n.s.). In addition, a significant increase from 4 permits (19 -19) to 90 permits occurred during the overcapacity period (1965-1969).

The most dramatic increase is found in the number of building permits issued for multiple family and motel/hotel units. The mean number of units permitted went from 90 units per year during the period 1965-1969, to 959 units per year from 1970 to 1972 (n.s.).

The nature of this increase cannot be explained in statistical terms. Nonetheless, an increase of this dimension would not appear to be a random event although, as previously noted, increases in multiple units follow national trends. It is reasonable to conclude that the expanded North Tahoe and Tahoe City plant has encouraged an extremely rapid development of multiple and tourist units on the California north shore.

Washoe County: No statistically significant changes in subdivision activity were determined for Washoe County, although several observed differences can be noted (Table VI - 27). Subdivision acreages have remained reasonably constant for each year during the period 1951 to 1970.

Period of Observation	Group 1		Group 2		Test Variable	Significance (P)	
	years	mean	years	mean		1 tail	2 tail
Group 1--preceding original plant capacity Group 2--Between original plant capacity and 1971 plant capacity expansion	1951-1961	249	1962-1970	200	building permits SF		
		7		155	building permits MF		
		72		68	acres/subdivision		
		106		155	lots/subdivision		
		1.6		2.4	lots/acre		
Group 1--Between original plant capacity and 1971 plant capacity expansion Group 2--Following 1971 major plant capacity expansion	1962-1970	200	1971-1972	141	building permits SF		
		155		313	building permits MF		
		68		23	acres/subdivision		
		155		N.A.	lots/subdivision		
		2.4		N.A.	lots/acre		

Table VI - 27: T-TEST RESULTS -- WASHOE COUNTY (IVGID)

The establishment of the Incline Village sewage treatment plant in 1962 was followed by an increase in lots per subdivision from a mean of 106 per year in 1951 to 1961, to a mean of 155 in 1962 to 1970 (n.s.). During the same periods, lots per acre increased from 1.6 per year to 2.4 (n.s.).

The number of single family building permits showed a slight decline in the second period (1962-1970) from 249 per year to 200 per year. Multiple family-motel/hotel permits jumped from a mean of 7 units in 1951 to 1961, to 155 units permitted per year in 1962 to 1970 (n.s.). In addition, since the 1971 Incline Village GID plant expansion, single family building permits have dropped from a mean of 200 per year (1962-1970) to 141 per year (1971-1972) while permits for multiple family units increased from 155 units to 313 for the respective periods.

Subdivision of Marginal Lands

A final observation should be made about the environmental quality aspects of subdivision control as related to the physical and ecological characteristics of the land subdivided in the Tahoe Basin. Since the provision of wastewater facilities has been determined to be a significant influence in land subdivision, an important question may be logically raised: to what degree was marginal land (i.e., land with limiting physical or ecological characteristics such as steep slopes, high erosion hazard, etc.) approved for subdivision activity?

To address this question an analysis was made of the geographic location of subdivisions in terms of two indicators of marginal land--slope categories and land capability (ecological classification of Tahoe Basin lands developed by the U. S. Forest Service) (USFS 1972; TRPA 1972a). First a dominant slope and land capability classification were determined for each subdivision. The subdivisions were next divided into five periods according to their approval dates. Then the slope and land capability of the respective periods were compared to determine differences or trends.

Slope: Low, moderate and steep slope conditions for land subdivision in the Tahoe Basin were categorized. Most moderate and steep slope lands (10% slope and above) have the potential for considerable erosion in the process of physical development given the characteristic of the dominant soils found in the Basin. The following observations and conclusions can be drawn from Table VI - 28.

Period	Slope Category	COUNTY								BASIN	
		El Dorado		Placer		Douglas		Washoe		Totals	
		acres	%	acres	%	acres	%	acres	%	acres	%
PRE 1950	<10%	3490	70	2360	61	590	53	220	48	6660	65
	10-25%	1010	20	1160	30	310	33	180	39	2660	26
	> 25%	520	10	320	9	40	4	60	13	940	.9
1951-1955	<10%	690	87	90	53	90	64	0	0	870	79
	10-25%	100	13	80	47	50	43	0	0	230	21
	>25%	0	0	0	0	0	0	0	0	0	0
1956-1960	<10%	1870	71	270	53	230	56	20	40	2390	66
	10-25%	680	26	230	45	160	39	20	20	1090	30
	>25%	70	3	10	2	20	5	40	40	140	4
1961-1965	<10%	1250	81	430	60	150	39	1040	60	2870	66
	10-25%	230	15	270	37	170	45	460	27	1130	26
	>25%	70	4	20	3	60	16	220	13	370	8
1966-1970	<10%	630	83	530	73	70	37	160	13	1390	48
	10-25%	130	17	200	27	90	47	920	75	1340	46
	>25%	0	0	0	0	30	16	150	12	180	6
TOTAL	<10%	7930	74	3680	62	1130	55	1440	42	14180	64
	10-25%	2150	20	1940	32	780	38	1580	45	6450	29
	>25%	660	6	350	6	150	7	470	13	1630	7

TABLE VI - 28: COMPARISON OF SLOPE CATEGORIES OF SUBDIVIDED LAND--FIVE YEAR PERIODS (1950-1970)

Source: Hand counted subdivision approvals on TRPA 1"=400' scale maps matched with UCSC Tahoe Data Bank Slope categories : <10%, 10-25%, >25%.

Prior to 1950 subdivisions had been approved on 10,200 acres; 6660 acres on slopes under 10%, 2660 acres on slopes between 10 and 25%, and 910 acres on slopes exceeding 25% slope. These acreages represent 65%, 26%, and 9% respectively; a distribution closely reflecting that for all land subdivided through 1970.

Major differences in the slopes of subdivided land occurred in three of the four five-year periods; one period--1966-1970--indicates a slope distribution which differs considerably from the other periods. During this period the subdivision of land on slopes exceeding 10% slope increases significantly, with 46% of the subdivisions in the 10-25% slope category. More than half of the subdivision activity in the late 1960's occurred on land with at least a 10% slope. This is primarily attributable to the development of Incline Village in Washoe County where over 1000 acres were subdivided on lands greater than 10% slope.

The influence of wastewater management facilities on the development of these lands cannot be directly determined, since similar slopes had previously been subdivided using septic tanks. If data on the septic tank limitations of soil types and geology were available, a specific analysis of this relationship between subdivided marginal land and sewerage treatment provision would be possible.

The slopes of subdivided lands differ considerably from north shore to south shore and between states. El Dorado County has both the greatest acreage (7930) and highest percentage (74%) of lands of less than 10% slope. While erosion potential should be less in El Dorado County, environmental problems associated with high water table, flood plains, wetlands, and meadows could occur.

In the Nevada counties the land available for development is considerably steeper, which largely accounts for the differences in development between the two states.

Land Capability: Lands unsuited for development (capability districts 1-3) have been grouped together as have lands which are capable of supporting residential and urban uses (districts 4-7) (see page 91 for a description of the USFS and TRPA land capability districts). A comparison between slope and land capability as measures of marginal land indicates that they do not define identical areas.

A significant change in the distribution of capability districts of subdivided land occurs in 1956-1960. El Dorado County, rather than Washoe County, is the dominant location of subdivided land in low capability districts (1670 acres) (Table VI - 29).

Lands subdivided prior to 1950 include some 4000 acres of land in low capability districts. Furthermore, by the time of TRPA formation (1970) over 9000 acres, or nearly fifteen square miles of low capability land had been subdivided. Under the TRPA land use ordinance, these lands would have been limited to land coverage of less than 5%. (See page 91 for a description of the TRPA land use ordinance). Using the TRPA land capability criteria, 42% of the presently subdivided land would never have been approved for subdivision due to potentially adverse environmental impacts including erosion, sedimentation, revegetation limitations and landslides and related surficial processes.

Additional data would be necessary to determine the specific influence of the provision of sewerage facilities on the development

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of marginal land. The fact that the amount of marginal land developed during the late 1960's when wastewater management facilities expanded rapidly leads to the implication that such provision did remove development constraints on a significant amount of land subsequently approved for subdivisions.

		COUNTY								BASIN	
Period	Land Capability	El Dorado		Placer		Douglas		Washoe		TOTAL	
		acres	%	acres	%	acres	%	acres	%	acres	%
Pre 1950	Low	2180	43	1180	31	490	52	170	37	4020	39
	High	2840	57	2660	69	450	48	290	63	6240	61
1951-1955	Low	320	55	20	12	140	100	0	0	400	44
	High	260	45	150	88	0	0	0	0	620	56
1956-1960	Low	1670	64	200	39	260	63	60	75	2190	60
	High	950	36	310	61	150	37	20	25	1430	40
1961-1965	Low	680	44	210	29	320	84	370	22	1580	36
	High	870	56	510	71	60	16	1350	78	2790	64
1966-1970	Low	170	22	220	30	170	89	640	52	1200	41
	High	590	78	510	70	20	11	590	48	1710	59
TOTAL	Low	5020	47	1830	30	1380	66	1240	35	9470	42
	High	5720	53	4140	70	680	34	2250	65	12790	58

TABLE VI - 29: COMPARISON OF LAND CAPABILITIES OF SUBDIVIDED LAND--FIVE YEAR PERIODS (1950-1970)

Source: Hand counted subdivision approvals on TRPA 1"=400' scale maps matched with TRPA land capability districts : Low=1,2,3; High=4,5,6,7.

SECTION VII

POLICY ANALYSIS AND EVALUATION

The purpose of this section is to present and evaluate selected aspects of the relationships between the development of wastewater facilities and changing land use patterns. The role and activities of the Federal and State agencies responsible for resolving water pollution concerns will be investigated first. In particular the planning and coordination of wastewater programs will be examined with respect to the consequent impact of these programs on land use patterns.

Coordination among agencies who provided a local response to water pollution issues is the second discussion point. A third area of concern is the examination of the effectiveness of land use regulation by public agencies during the periods of expansion of wastewater treatment facilities. The transition from local to regional land use planning and regulation is the final topic of discussion.

Selected Findings

--Engineering and costs considerations were the major, if not the sole concern of Federal review of applications for wastewater grants.

--A 1971 wastewater plant improvement project report does not mention land use or development in its federally required assessment of impacts even though the project would double the plant's treatment capacity.

--A June 1973 environmental impact report on expanding the Tahoe City PUD system acknowledges that construction of sewage collectors will remove a serious economic constraint on development in an area zoned General Forest which explicitly prohibits residential use.

--Natural limits on the amount of water for domestic supply have not been thoroughly evaluated in wastewater studies, particularly in view of the Bi-State Water Compact allocation limits and the export of sewage (with attendant domestic water) from the Basin.

--The TRPA plan severely limits new residential subdivision activity; while permitting means of exceptions to land coverage constraints for multiple residences and commercial uses of high intensity on land zoned appropriately before TRPA, but which has been shown to be highly susceptible to development disturbance (Low land capability districts).

--Wastewater treatment facility impacts were not a central consideration in the development of the TRPA plan. Reports prepared for the agency are vague, contain much inconsistent and incomplete data, and do not provide a sufficient information base from which to guide regional decision-making.

Government Response to Lake Tahoe Water Pollution Concerns

Federal and State Programs

The present forms of the wastewater treatment systems at Lake Tahoe are partially the result of conditions unique to the Basin, but are also a reflection of overall water pollution control strategies of the federal government and the states of California and Nevada. This discussion briefly examines the major federal and state programs affecting water quality in the Tahoe Basin.

The federal government has directed and assisted the states in their efforts to achieve clean water. The 1965 Federal Water Pollution Control Act (FWPCA) amendments provided federal construction grant funds (30% up to a limit of $250,000) for municipal treatment facilities (Davies, 1970). Conference procedures for federal involvement and enforcement in interstate water quality problems were also established.

These amendments further called for the establishment of water quality standards and for implementation plans for all interstate waters. Provisions were also made to increase the federal share to 55% when states contributed an additional 25% of the cost and met certain other requirements including prior planning for water quality.

The two states each promulgated their own water pollution control laws. In 1949 Nevada approved a law and regulations to protect the Lake Tahoe Watershed (Nevada State Division of Health, 1958). The state in 1967 set water quality criteria for the Lake as required by the federal act. Upon approval by the FWPCA in 1968 these criteria became State-Federal water quality standards. Nevada did not, however, develop a construction assistance program.

California, operating under the Water Quality Act of 1949 (the Dickey Act) established state and regional boards to manage water quality programs and administer federal grants. The act also set up a loan program for assistance in treatment facility construction. For several years after 1966 the funds available for such loans were earmarked for the Lake Tahoe area (California Water Resources Control Board (WRCB) ,1969).

The state adopted policies for Lake Tahoe water quality in 1967. The following year the FWPCA approved these policies as State-Federal water quality standards. In 1969 the California legislature passed the Porter-Cologne Water Quality Act which included special provisions for the connection of all buildings to a district sewage system and export of treated waste from the Basin (California WRCB, 1972).

The passage of the California Clean Water Bond Act of 1970 enabled the state to participate in the federal matching grants program and led to the formulation of more detailed requirements for planning for water quality. As a result of the Clean Water Act the funding ratio changed to 55% federal; 25% state; and 20% local.

The 1972 FWPCA Amendments maintained the existing federal approval standards, but changed the funding ratio again. Presently the federal share is a flat 75%, regardless of any state contribution. Presently California divides the remainder equally with the particular locality--12 1/2% each. In Nevada, the local share is 25%.

State and Local Activities: During the 1950's and early 1960's pollution resulting from sewage disposal was considered the major threat to the water quality of Lake Tahoe. Predictably, actions were taken on all jurisdictional levels to limit pollution. Unfortunately, the actions were not coordinated, nor were they consistent among counties or between states. The plans and commitments of local wastewater management districts were seldom considered by larger governmental agencies concerned with land use problems.

State and local actions to limit pollution are summarized below. These activities have been selectively compiled from "Lake Tahoe," the newsletter of the Lake Tahoe Area Council. (A more comprehensive chronicle appears in Appendix A.)

Nevada State and Counties: Nevada first acted to limit water pollution in the Tahoe Basin by the 1958 adoption of a "Law Relating to Protection of Lake Tahoe Watershed" and "Regulations Governing the Lake Tahoe Watershed." These regulations stated:

> Subdivision plans shall not be approved (by the Bureau of Environmental Health) unless there is provision for service to an approved sewage collection, treatment, and effluent disposal system, and a surface drainage system, all with capacity to accommodate the volumes anticipated without contamination of a water supply or violation of Water Polution Regulations. (Nevada State Division of Health, 1958; Reg. #8)

The Board of Health in Nevada chose also to restrict the issuance of permits for large commercial projects. Gaming facilities were the major customers in two Nevada sewerage districts, Washoe and Douglas County SIDs. Building permits for new casinos were delayed when each district reached the contractual limits of sewage capacity negotiated with the adjacent California districts. This action represented the first attempt to restrict growth on the basis of a lack of available capacity in existing treatment plants.

In 1963 the State Bureau of Environmental Health requested that the Washoe County Planning Board discontinue issuing permits for developments contributing sewage in excess of 2,000 gallons per day. The Board of Health banned all new commercial construction in Douglas County in 1965, while requiring minimum lot sizes of 10,000 square feet (nearly 1/4 of an acre) where septic tanks were to be installed.

Two years later, in June 1967, the Board of Health adopted a Regional Water Quality Implementation Plan, calling for export of all effluent by 1970. Governor O'Callaghan issued an executive order in January 1971, prohibiting further septic tanks in the Nevada portion of the basin and requiring all existing tanks to be sealed and converted to holding tanks. In May of 1973 the Federal District Court decreed a new building ban within the boundaries of two of the last sewage districts planning to build collection systems (Tahoe-Douglas and Kingsbury) until the systems could begin service. This ban did not take effect until December 1973.

California State and Counties: Restrictions on a minimal allowable lot size and wastewater flows tended to limit the extent and intensity of subdivisions lacking sewage treatment facilities. For example, in 1958, El Dorado County required a lot size of 10,000 square feet minimum if it contained either a well or a septic tank, and 20,000 square feet if it contained both. Only 6,000 square feet were required if both water and sewer lines were available. The consultants for the STPUD sewerage survey sum up the impact of these requirements clearly: "Anywhere from two to three times as many lots can be developed in tracts served by public water and sewerage systems than in tracts lacking either one or both of those services." (Brown and Caldwell, 1959, p. 24)

In 1962 the Placer County Board of Supervisors also adopted a requirement that only those lots with at least 10,000 square feet would be allowed to use septic tanks. During the same year, the Lahontan Regional Water Quality Board issued the first cease and desist order against the South Tahoe PUD because of overtaxed holding ponds; a situation which was ameliorated when the District acquired more land for effluent disposal.

By 1965 El Dorado County required that new subdivisions install sewers before housing construction began. The Tahoma area was an exception, as large scale building was allowed on septic tanks. An example of this was the "Water's Edge Condominiums" a 39-unit development in Tahoma, which had a 2,000 gallon per day leaching field 300 feet from the lakeshore. The Lahontan Board later required both well monitoring of this system and sewer hook-ups as soon as facilities were available (which came in 1972 with the annexation of this area to the Tahoe City PUD).

Placer County began to enforce a similar requirement for new subdivisions in 1965. Several other policies were also in effect in Placer County. First, all septic tank permits were considered to be of a temporary nature, expiring as soon as a sewage export system was available. Second, septic systems discharging more than 2,000 GPD were not permitted. Third, any subdivision with a density of 3 units per acre or greater was required to form a county sanitation district (under jurisdiction of the Board of Supervisors) to facilitate later incorporation into an existing district.

The Tahoe Regional Planning Commission adopted a resolution in 1965 requesting that each county require sewer lines in all new subdivisions. In early October the Lahontan Regional Water Quality Control Board (LRWQCB) issued a cease and desist order against the South Tahoe PUD after excessive overflows from its treatment plant began reaching Lake Tahoe. Later that month LRWQCB sought an injunction against STPUD for continued violation of the cease and desist order.

In December of 1965 the Lahontan Board considered, but subsequently rejected, the imposition of a building ban at South Lake Tahoe, stating that it had no authority to do so. The El Dorado County Board of Supervisors took the same position. There is a clear disparity between the California authorities' powers, as reflected in this unwillingness to take action, and the Nevada Board of Health, which could rely on the permit process established in the "Laws and Regulations Governing the Lake Tahoe Watershed" adopted in 1958.

The North Tahoe PUD informed the Placer County Health Department in May, 1966 that its sewage flows were approaching the plant's capacity and that it could not hook up more than a few single family dwellings. In June, the Lahontan Board adopted its Water Quality Control Program, which included a provision to prohibit any sewer connections that would overburden the system (Policy 6B). Unfortunately, the Lahontan Board had no power to enforce this provision. The Water Quality Control Program set no deadline, but encouraged the enactment of state legislation and local ordinances to require collecting, treating, and exporting all sewage produced in the Lake Tahoe Basin.

The Federal Enforcement Conference of July, 1966 set a goal of completing the connection of all developable land to a treatment and export system by 1970, and recommended legislative programs designed to achieve that goal.

The LRWQCB in May, 1967 adopted Regional Water Quality Standards which required export to be completed by 1970. Meanwhile the North Tahoe PUD continued to experience grave problems with its sewage treatment plant. A building ban was imposed finally by Placer County in 1967 based on inadequate treatment capacity (Ayer, 1971). The Lahontan Board issued a cease and desist order for overflows caused by an early spring thaw and the resulting infiltration of snow melt into the lines. This order was later rescinded in March 1968 when an extensive sewer sealing program was undertaken.

In 1968 the California Legislature adopted the 1970 deadline for sewage export, although in 1969 the deadline was amended so as to go into effect on January 1, 1972.

The Lahontan Board issued another cease and desist order against both North Tahoe and Tahoe City PUD's because of over burdened facilities in 1971. This time, however, the Board took the initiative of restricting new sewer hook-ups (tantamount to a building ban, since Placer County no longer allowed unsewered construction) except for limited approvals by the Executive Officer. The order was rescinded on January 29, 1972 after increased disposal capacity at the Cinder Cone was granted by the U.S. Forest Service. Meanwhile, the Regional Office of the Federal Housing Authority announced a temporary moratorium on FHA loans in the Tahoe Basin, until an adequate sewer system for the North Shore could be provided.

On July 26, 1972, the Tahoe Regional Planning Agency, only a year-and-a-half old, adopted a resolution requiring prospective developers to prove the adequacy of not only sewage systems, but other utilities.

Though all jurisdictions did indeed take an active and progressive role in requiring sewer connection and construction for new developments, these requirements were seldom tied in with timetables for the expansion of actual plant capacities (see Table VI - 14). County Boards of Supervisors and Regional and State Boards have shown great reluctance to interrupt building activity while sewage plant capacities were being increased.

This reluctance seems analogous to the difficulty in securing a state of emergency proclamation (normally issued only after a natural disaster) in order to prevent an almost certain catastrophe. The extreme fire danger potential of storm-downed and frost-killed trees around San Francisco Bay in 1973 provides a good example. Citizens requested that various authorities fund a fire preventive cleanup. The response was that there is no legal precedent for using emergency funds in advance of a disaster.

Influence of Water Quality Projects on Land Use

There is little evidence at Lake Tahoe of in-depth examination of influences or impacts of proposed wastewater systems on land use. This is partly because documents which were called regional wastewater plans merely provided a general discussion of the need for and location of facilities. A second reason is that discussion in plans of impacts on the land use pattern was only recently required.

Several pollution control plans were promulgated by the water quality agencies dealing with Lake Tahoe (the Lahontan Regional Board representing the California State Water Resources Control Board and the Bureau of Environmental Health acting in Nevada). The first of these, a Report on Water Pollution Control, Northwestern Lahontan Basin (U.S. Public Health Service, 1953) was a joint effort between these state agencies and the U.S. Public Health Service. It merely compiled a list of needed treatment facilities.

California and Nevada each prepared an implementation plan for the Lake Tahoe Water Quality Standards in 1967 as a response to federal requirements (California RWQCB Lahontan Region, 1967a; Nevada Department of Health and Welfare, 1967). Both plans incorporated the requirements of collection and export suggested in the 1963 Lake Tahoe Area Council sponsored Comprehensive Study (Engineering Science, 1963) on waste disposal.

None of these studies draws a connection between wastewater treatment and the type and/or intensity of land uses in a given area. In addition these official reports make no attempt to explain the basis for projecting future treatment needs (see Appendix C), nor do they examine the effects of projected population growth implied by future treatment needs. As an example the California 1967 implementation plan makes no mention of the Tahoe Regional Planning Commission "1980 Plan."

Even when comprehensive planning under EPA Directive 18CFR 601 (U.S. Environmental Protection Agency, 1971) became a prerequisite for obtaining federal construction grants, there was no requirement that land use impacts be cited. The California Lahontan Regional Water Quality Control Board adopted an Interim Basin Plan (California RWQCB, Lahontan Region 1971a) to fulfill comprehensive planning requirements, but Nevada officials, foreseeing no immediate aid requests, did not formulate a plan.

The California plan took a form similar to previous efforts; i.e., setting standards, listing discharge prohibitions and examining ways to achieve water quality objectives--again through a facilities list.

The level of generality was high; no plant sizes or projected service populations were listed.

The Interim Basin Plan recognized that "potential problems in the Truckee River Watershed (including Lake Tahoe) stem from the predicted increase in development" (California RWQCB Lahontan Region, 1971a, p. 11). However, the plan did not indicate the magnitude of development and did not suggest a strategy for controlling or reducing growth.

Grant Review and Environmental Impact Statements: Federal and state review and evaluation of construction grants did not lead to a comprehensive and integrated planning process. Interviews with EPA officials responsible for review of grant applications for the Basin during the mid-1960's reveal that the engineering and cost aspects of the projects were the major if not sole concern, and that secondary impacts and the relationship of the treatment capacity to land development or land use plans were not considered to any significant degree (personal interviews with Vern Tenney and John Wise, May 1973). These interviews are corroborated by the lack of explicit federal or state guidelines or policies requiring investigation beyond engineering aspects during the period in which the treatment and export systems were expanded to their present dimensions.

California entered the grant-review process with the passage of the Clean Water Bond Law in 1970. A newly formed grant program team promulgated a set of "Project Report Guidelines" in July 1971, (California Water Resources Control Board, 1971a) requiring inclusion of extensive and detailed planning information.

Among the most crucial items required were an accounting of the methods used to develop service population forecasts, and a comparison with other forecasts made for population of the area. Also required were a discussion of project conformance to the Basin Water Quality Management Plan and other pertinent regional and official plans (such as the TRPA plan) and an environmental impact report.

The Environmental Impact Statement (EIS) process is an important part of the grant review. It is a vehicle for evaluating the impacts of projects for which grant aid has been requested, and could provide a framework for identifying such secondary impacts as the effects of a project on land development and the pattern of urbanization, and could provide for the evaluation of subsequent water quality impacts of that development.

Figure VII - 1 depicts the present intensive review route for proposed projects. Note that an environmental assessment is required

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by the California Environmental Quality Act (CEQA) as part of the project report.

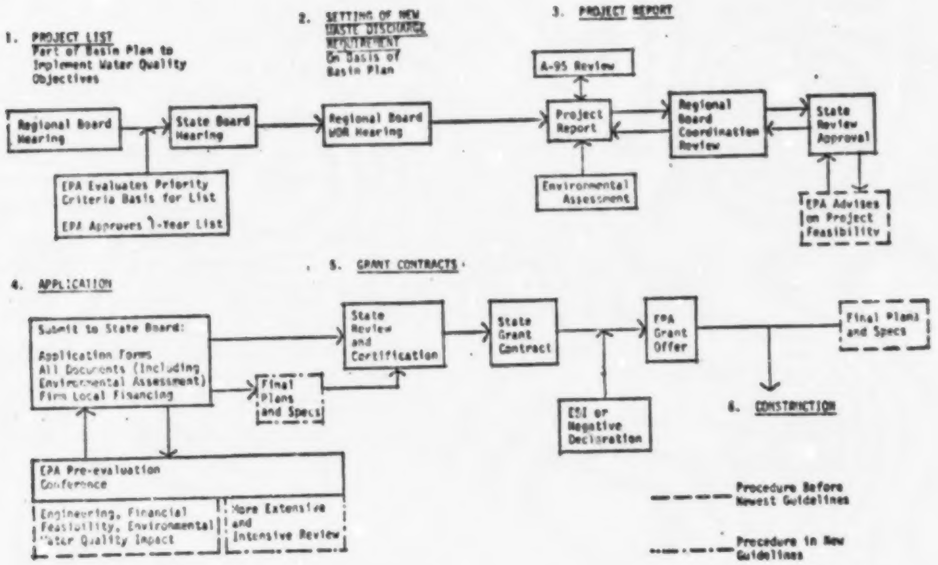

1. PROJECT LIST
Part of Basin Plan to Implement Water Quality Objectives
2. SETTING OF NEW WASTE DISCHARGE REQUIREMENT
On Basis of Basin Plan
3. PROJECT REPORT
Regional Board Hearing
State Board Hearing
EPA Evaluates Priority Criteria Basis for List
EPA Approves 1-Year List
Regional Board WDR Hearing
A-95 Review
Project Report
Environmental Assessment
Regional Board Coordination Review
State Review Approval
EPA Advises on Project Feasibility
4. APPLICATION
5. GRANT CONTRACTS
Submit to State Board:
Application Forms
All Documents (Including Environmental Assessment)
Firm Local Financing
Final Plans and Specs
State Review and Certification
State Grant Contract
EIS or Negative Declaration
EPA Grant Offer
Final Plans and Specs
6. CONSTRUCTION
EPA Pre-evaluation Conference
Engineering, Financial Feasibility, Environmental Water Quality Impact
More Extensive and Intensive Review
Procedure Before Newest Guidelines
Procedure in New Guidelines

Figure VII-1: WASTEWATER GRANT REVIEW PROCESS (CALIFORNIA)

The Environmental Impact Statement, a key provision of the National Environmental Policy Act (NEPA, 1970), has been required for federal projects which would created significant environmental impacts. A similar document--the Environmental Impact Report (EIR)--has been required since 1970 for California projects falling under provisions of CEQA. The EPA treats this document as the environmental assessment upon which it bases its decision on whether to write its own EIS or to issue a "negative declaration" stating that there will be no significant impact from the project.

The environmental impact reporting process has undergone considerable evolution since enactment of laws providing environmental quality controls but there has been little change in the basic issues. The concerns raised above have remained: the strength of state and federal guidelines for determining the need for a statement; the scope and detail required when a statement is deemed necessary; and the degree to which these guidelines are implemented on a case by case basis.

It is important to note that at Lake Tahoe the major expansion of both sewerage district boundaries and treatment capacities was completed by 1971. These expansions were not affected by the requirements for environmental impact statements.

The importance of considering secondary impacts of a project was underscored in the 1971 CEQ guidelines. These guidelines required that,

> . . . implications, if any, of the action for population distribution or concentration should be estimated and an assessment made of the effect of any possible change in population patterns upon the resource base, including land use, water, and public services, of the area in question. (CEQ, 1972, p. 407)

While these guidelines were in effect, impact assessments were prepared for South Tahoe PUD's plant improvements (Cornell et al., 1971), and Tahoe City and North Tahoe PUD's Dollar Point lift station (Dewante & Stowell, 1972); and plant improvements (Dewante & Stowell, 1971a). These assessments were extremely brief and emphasized the justification of the project.

The STPUD plant improvements report does not mention land use or development, although the project would double the firm treatment capacity of the district's plant. The north shore Dollar Point lift station report devotes only a paragraph each to population growth and land use, but makes a significant comment:

> The project will of itself have no effect on population concentration or distribution, but is part of an overall sewerage system which is in compliance with planning for the area by the Tahoe Regional Planning Agency (TRPA) and other concerned agencies, and this project will restrict growth to the planned growth of the region in compliance with the recently proposed restrictions of TRPA for the Lake Tahoe Basin. (Dewante & Stowell, 1972)

In fact, the TRPA population figures used to calculate the capacity for the lift station (29,500 people in 1990 and 39,000 at saturation density in 2020), have been subsequently reduced by one-third to 26,100 at saturation (Walters Engineering, 1973). However the project was granted funds to provide for the higher service level which now conflicts with newer TRPA population projections. This situation emphasizes the need for supplementing a statement on the project's conformance to existing plans with an independent evaluation of the impacts of the changes in land use facilitated by that project.

In early 1973 California took a step towards evaluating impacts on land use by requiring a new report section which will:

> discuss the ways in which the proposed project could foster economic or population growth either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth (a major expansion of a wastewater treatment plant might, for example, allow for more construction in the service areas). (California Resources Agency, 1973)

Two impact assessments written to meet these guidelines are evaluated below. The first is an environmental impact assessment for the Tahoe-Truckee Sanitary Agency Regional Sewerage Plan (which includes TCPUD and NTPUD), originally produced in February 1973, and amended in May to conform with the new guidelines. It acknowledged the land use impact of several alternatives. Regarding one alternate the EIA states that:

> proposed sizing of the interceptor between Lawton and Reno would permit the projected population to expand . . . thus the interceptor would open an area to development in what appears to be an unplanned manner. (Jones and Stokes, 1973, p. 491)

In assessing the effects of the interceptor between Tahoe City and the proposed treatment plant in Martis Valley the report states:

> community growth in this area will cause a degradation of the social, aesthetic and ecological environment of the Truckee River Canyon . . . greater congestion . . . degradation of air quality, increased noise, and the possible conversion from wild to suburban-urban atmosphere. (Jones and Stokes, 1973,)

Having recognized this probability, though, the assessment made no attempt to propose a mitigation of these negative impacts. Rather, it leaves this issue to the land use planners:

> Whether this projected growth takes place is dependent upon the planning agencies responsible irregardless (sic) of whether they are state, county or city agencies and not on TTSA. Growth planned to gain the maximum benefit from the environment must be done by properly constituted planning agencies. (Jones and Stokes, 1973, p. 119)

The EPA announced in May 1973 that it would prepare an EIS for the project. This decision was based on EPA "Interim Regulations for the

Preparation of Environmental Impact Statements" of January 1973 which call for a statement when "treatment works will induce or encourage significant changes in industrial, commercial, or residential concentrations or distributions" (U.S. EPA, 1973).

If the environmental assessment of the Tahoe Truckee Sanitation Agency sewerage plan places unwarranted faith in the ability of the land planners to implement their plans, the second and most recent wastewater EIR available for review (a project to expand the Tahoe City PUD collection system) deals a serious blow to the attempts of planners to regulate land use. The Draft EIR for Sewer Assessment District No. 7C (Dewante and Stowell, 1973) acknowledges that construction of the collection system will remove a serious economic constraint on any development currently using holding tanks. The report then states that TRPA would prefer no dwellings in this area which is designated General Forest, a land use classification which explicitly prohibits residential uses (TRPA 1972a).

The report goes on to establish that the TRPA has lacked the resources to purchase these lands; that the project would dramatically increase the value of the subdivided lots in the project area, placing them further out of the reach of the TRPA or any other body purchasing land for preservation; and that in view of its inability to purchase the lots, TRPA has felt obligated to allow one dwelling unit on each parcel.

The EIR concludes that since the size of these dwellings is restricted in relation to lot size and the dwellings are subject to normal building permit review procedures, the controls "would appear adequate to control . . . growth." (Dewante & Stowell, 1973, p. 24). The authors of the environmental impact report thus avoid the more logical conclusion that the net impact of the action they purport to evaluate is to frustrate the original TRPA plan which allowed no dwellings in the area; a condition that would continue if the project were not to change it.

Awareness of the relationship of wastewater facilities to land use and development is growing. Regulatory mechanisms are being created to deal with that relationship. Yet there is little basis for a determination that these mechanisms will actually insure an adequate meshing of wastewater and land use planning.

Local Sewerage District Activities

The physical parameters of the development and expansion of sewerage districts is discussed above in Section VI under Measures of Wastewater Management Activity.

Policy analysis of sewerage district decision-making has not proved to be possible within the limits of this research. Specifically an analysis of the relationships between location of collector and trunk lines and subdivision or building activity could not be done; nor could an analysis of financing be made.

Limited data on the approximate location and year of the installation of collector lines (aggregated by assessment district) was available only for the South Tahoe PUD. However, inspection of subdivision activity in STPUD's service area showed that the subdivision pattern was already established by 1960 when septic tanks were still the predominant wastewater disposal system.

As discussed in section VI, cost accounting for the development of Tahoe Basin sewerage systems has been very inconsistent. In addition, information on the effect of holding costs on property owners which would be likely to influence individual development decisions has proved impracticable to collect.

The total costs to an individual owner of a subdivided lot for mandatory sewerage system installation would include the following: charges for sewerage district annexation; property tax rate increases; rises in assessed valuation since property is more valuable when sewered; special assessments for collector lines to reach his lot; and fees for hookup, operation and maintenance of the system. No information has been found to determine whether the magnitude of such costs forced lot owners to develop their property, to increase the intensity of development, or to sell the property.

No Tahoe Basin study has discussed such holding costs, nor has any federal agency attempted to assess the impact of these holding costs when grants for wastewater facilities were approved. Such an analysis should include a study of the impact of various ways of raising revenues to support capital construction.

Revenue bonds, in particular, appear to depend on future population growth to retire them in order to avoid unduly burdening present property owners. In addition questions of economic equity such as whether seasonal users and day and overnight visitors pay for a fair share of the cost of wastewater treatment have not been analyzed (or even discussed) in any existing Tahoe Basin studies.

The actual influence of local government land use plans on sewerage district plans is not clear. A review of major wastewater feasibility and project reports published prior to 1970 showed no detailed reference to locally adopted land use plans. No evidence has been found in treatment plant feasibility studies to show that there was any cooperation with county land use planners in their preparation. Sewerage districts, of course, are not by law required to coordinate their planning efforts with those of any other agencies or jurisdictional levels.

Sewerage District decisions were however substantially influenced by the private sector. The expansion of gaming appears to have been contingent upon the availability of sewage treatment. As noted by South Tahoe PUD engineering consultants; " . . . it had long been established that the neighboring gaming establishments in Douglas County were in dire need of an adequate sewerage system." (Brown and Caldwell, 1959, p. 6) To provide this service, "a district was formed (Douglas County SID #1) on the Nevada side to permit the gaming casinos to contract with the South Tahoe Public Utility District for treatment and disposal of their sewage." (California Regional Water Quality Control Board, 1970b) This contract ended in 1968 when the district began operating its own facilities.

These activities indicate that the construction of sewage treatment facilities was an acknowledged precondition for the growth of gaming casinos at the South Shore. The significance of this precondition cannot be underestimated since by 1970 one-third of the total visitor days in the Tahoe Basin were directly attributable to gaming (Economic Research Associates, 1971).

Special districts are governmental agencies with limited powers. Under state law they may condemn land, enter into contracts, levy certain taxes and assessments and sell bonds. Since 1963 in California the formation and expansion of such districts has been subject in each county to the approval of the Local Agency Formation Commission (LAFCo). (California Government Code sec. 54773, et seq.) The central task of a LAFCo is to limit the number of new districts formed and to encourage districts to expand into contiguous areas rather than leaving pockets of skipped-over territory. (See Appendix B for discussion of special district statutes.)

LAFCo officials have interpreted their enabling legislation which states that annexations should be logical and orderly to mean that an annexation to an existing district is preferable to the creation of a new district. Additionally the Federal Enforcement Conference (USFWPCA, 1966) specifically required that the districts annex all developable land, as part of mandated sewering of the basin. This they have done, mostly since 1966 (Table VI - 15). The net result of these events has been the rapid expansion of both service area and sewage treatment capacities.

The Critical Relationship Between Wastewater Treatment and Water Supply

Water supply and distribution is potentially the most limiting factor to future urbanized development at Lake Tahoe. The availability of domestic water supply is intrinsically connected to current wastewater treatment technology. This relationship deserves special attention at Lake Tahoe where existing and planned sewage export will remove large amounts of domestic water from the Basin. This Basin contains

64 watersheds which drain into Lake Tahoe, and the lake in turn is the source of the lower Truckee River. This bi-state river has long been deficient in supplying downstream demand (Brown and Caldwell, 1959, p. 24).

A quantitative analysis of the relationships between water supply and land use patterns is beyond the scope of this research. In addition, there appears to be no current or historic data available on water system flows or capacities to make such an analysis possible. The basin-wide description of water supply and distribution in a recent TRPA draft study, Lake Tahoe Water, Wastewater & Drainage prepared by Walters Engineering follows in its entirety:

> There are currently 82 separate water purveyors in the Lake Tahoe Basin of which some have multiple isolated water systems . . . The size of water systems in the Lake Tahoe Basin vary from two to 2300 customers. All but a few of the present water distribution systems are inadequate, resulting in inadequate domestic service and fire protection. Such inadequacies have negative impact with respect to public health, esthetics and in the form of higher fire insurance rates (Walters, 1973, unpaged).

There have been numerous studies dealing with the question of sufficiency of water supply and distribution. As early as 1948 California and Nevada investigated the impact of population growth in the basin on the amount of water flowing from the lake which was available to downstream users (California Department of Public Works, 1949; 1949a).

The consensus of opinion in these reports indicates that increased water use due to population growth would cause only minor impacts on the total amount of water in the Basin's watersheds. This information was based on lower than present-day estimates of per capita water use (50 gallons per capita per day /GPD/); plus the assumption that 50% of the water used would be returned for ground water recharge through septic tanks, and through the irrigation of lawns and golf courses. In addition, extensive clearing of vegetation was expected to eliminate some existing water consumption due to transpiration losses. The net water use utilized in the 1948 studies was 25 gallons per capita per day. Given this low per capita water use and the assumption that basin population would double in 25 years to approximately 60,000 peak summer residents, the study concluded that water supply was more than adequate for both Basin and downstream users.

In 1955 the California and Nevada legislatures created a "California-Nevada Interstate Compact Commission" to formulate an interstate compact for regulating water use in the bi-state Truckee, Carson and Walker River Basins. Studies on water use and hydrology prepared for the commission concluded that there was insufficient water to meet all probable future demands within the basins. This conclusion led to the declaration of the river basins (including the Tahoe Basin) as water deficient areas.

In 1959 another study was undertaken to estimate future water requirements of the Lake Tahoe Basin apart from the other basins draining into the Truckee River (Muth and Banks, 1959). This study was prepared for the Interstate Compact Commission by the State Engineer of Nevada and the Director of the California Department of Water Resources (DWR). It assumed a future peak population of 398,000 and predicted a maximum water consumption of 17,200 acre feet per year and a minimum use of 9,100 acre feet per year. The study also predicted that runoff into the lake would increase significantly due to urbanization (vegetation clearing, impervious surfacing, etc.). This increase was estimated to range from a maximum of 22,000 acre feet to a minimum of 11,900 acre feet. When these data were combined, it was concluded that there would be no depletion of the inflow to the lake, assuming a peak population of 398,000. In fact, an increase in runoff to the lake was predicted which would exceed the increased water use of future populations. Again, intense urban development of the basin was considered to have little impact on the total basin water budget.

Water diversions in the Tahoe Basin are now limited to a maximum of 34,000 acre feet per year; 23,000 acre feet to California and 11,000 acre feet to Nevada. The limitation was formulated and discussed in the early 1960's but not officially agreed on by both states until 1968 (ratified by both states but not yet by Congress). This appears to indicate the existence of an abundant supply of water considering the 1948 and 1959 DWR studies of projected ultimate water needs. However, several new factors need to be weighed to estimate future water use more accurately.

First, there has been a significant increase in average per capita water use. The estimate of 50 gallons per capita per day (GPD) used in 1948 had increased to 100 in 1959 and increased again to 118 in 1962. ESI in their "Comprehensive Study" for the LTAC estimated that per capita water would increase to 140 gallons per day by 1980 (Engineering Sciences, 1963). Per capita water use for 1972 has been estimated at 140 GPD in California and 193 GPD in Nevada (Walters, 1973);reinforcing the expected trend toward higher per capita use.

A second factor which influenced the water allocation formula was the decision to export all sewage effluent from the Basin. The earlier DWR studies assumed that 50% of the water used in the Basin would be returned through groundwater recharge. If all effluent were to be exported out of the Basin no recharge would occur except for water used to water lawns and golf courses.

Third, population projections for the Basin had been revised sharply upward. An influential 1963 study projected a peak day population of 596,000 persons by 2010. This reflected increased occupancy factors due to year-round recreation including skiing, water sports, and casinos (Engineering Sciences, Inc., 1963).

Future basin water use has been forecast in many studies, with varied conclusions. The 1973 study by Walters Engineering for TRPA used population projections provided by Economics Research Associates which were based on assumptions concerning the actualization of the TRPA land use plan. Each watershed was assigned an ultimate saturation population to allow projections of future water use. The resulting population capacity for the Basin was projected to be 214,280. Then two forecasts of future water use based on this projection were made, with and without water conservation measures. Present demand was estimated as well. The totals for each state are indicated in Table VII - 1.

	PRESENT DEMAND	PROJECTED DEMAND WITHOUT CONSERVATION MEASURES	PROJECTED DEMAND WITH CONSERVATION MEASURES
CALIFORNIA	11.1	34.2	18.2
NEVADA	4.7	8.8	4.5
BASIN	15.7	43.0	22.7

Table VII - 1: PRESENT (1972) AND PROJECTED WATER USE IN THE TAHOE BASIN (thousands of acre feet per year)

Source: Walters Engineering, "Lake Tahoe Wastewater and Drainage Study," TRPA, 1973

The still unofficial Bi-State Compact allocates a maximum of 34,000 acre feet of water per year to the Basin. California would receive a 23,000 acre foot allocation and Nevada 11,000 acre feet. Clearly water conservation measures must be taken if ultimate water use in the Basin is not to exceed the limit set by the Interstate Water Compact.

The Walters Engineering Study does not spell out the assumptions made in order to calculate future per capita water use. Water use has consistently increased in the Basin and nationwide as well. The study does not discuss what water conservation measures should be utilized, nor who would enforce them, nor what impact such measures might have on efficient wastewater treatment.

Local and Regional Regulation of Land Use

Until the advent of the TRPA in 1970 Tahoe Basin land use planning was undertaken by counties and the City of South Lake Tahoe. General plans, zoning and the issuance of subdivision approvals and building permits were functions carried out by county governments located considerable distances from the Tahoe Basin (see Figure V - 3). The land use classifications designated by these local plans were not legally binding on land owners. General plans were used as a broad framework for future land use and were not required to reflect existing zoning. The future uses of land as indicated on general plans were naturally in excess of actual land uses to allow for growth. Appendix B contains a detailed discussion of the statutes which define the planning function in California and Nevada local government.

Land use planning in the Lake Tahoe Basin has been the subject of ongoing controversy during most of the period covered by this research. Conservation interests continuously sought legislative action to override the land use decisions of local governments during the 1960's (Jackson and Pisani, 1973). Public policy questions which dominated the debate included whether land speculation was encouraged through a lack of subdivision control, whether major pro-development bias was evident in general plans, whether marginal lands (steep slopes and fragile soils) were being approved for development, and whether regional and/or national public interest in the planning process was being represented in the local land use planning process (Brandt, 1971; Bronson, 1971). The formation of the TRPA was expected to bring more environmentally responsive land use planning to the Lake Tahoe Region (Lake Tahoe Joint Study Committee, 1967).

The following discussion elaborates on the policy issues delineated above using subdivision activity as a land use indicator, and evaluates the effectiveness of local and regional planning and management of environmental resources in the Tahoe Basin. Subdivision data is the most consistent, accurate, and reliable land use measure available since records of zoning and land use district changes are virtually non-existent. The subdivision data utilized in this report was collected from county departments and the TRPA and entered in the UC Santa Cruz Tahoe Data Bank for purposes of spacial and multivariate analysis.

Subdivision Control

The sheer magnitude of subdivision activity has been a source of ongoing controversy. A total of nearly 50,000 lots have been approved in the Tahoe Basin (Table VI - 3). Subdivision approvals have far outstripped the construction of houses in the Basin. Currently there are an estimated 30,000 vacant lots (Economic Research Associates, 1972a). This surplus of lots effectively limits the possible use of these lands to single family housing units.

Another result of excessive subdivision approvals is to delay any impacts on the environment (see Figure IV - 1). The environmental quality impacts of the development of the existing 30,000 vacant lots would be of major proportion. A high percentage of the properties could be built upon since they are included in appropriate use districts but excluded from land coverage constraints set forth in the Land Use Ordinance (TRPA 1972a).

When land is made available through planning, zoning and subdivision approval mechanisms for uses requiring construction, the owners of that land acquire legally enforceable rights to build. These rights can only be taken back by the slow and politically difficult process of making planning and zoning adjustments. This task is not made easier when land owners with economic interests, sanctioned by the original planning, zoning and subdivision approval, attempt to protect their investment.

Rural counties have historically tended to approve subdivisions without critical review because the combined tax assessments on the individual subdivided lots is considerably higher than on the original undivided parcel. The county tax base can be greatly increased through subdivision activity without requiring the county to provide public services.

Another important economic factor in subdivision activity is the marketing system. Subdivision promoters in rural areas often work on a large scale. The cost of market analysis and sales promotion is high; as is the overhead which is attributable to the fact that few of the home site buyers are local residents. The development project must be advertised in distant metropolitan areas. These added costs generally require the second home subdivision developers to minimize on-site costs. Since second home sites sell more rapidly than do second homes, the subdivider is also able to avoid committing capital to a costly construction operation by limiting promotion to the sale of second home lots.

The new owner of a subdivided lot essentially has only two approaches possible for managing his property; at some future date the owner will either improve or sell the property. The latter choice, often undertaken with investment in mind, is generally referred to as speculation. Since there are 30,000 vacant lots in the Basin, it may be assumed that a considerable portion of the subdivided land is held by land speculators.

Land speculation, by its very nature, removes land from the market. Because the amount of land available to meet the market demand is very limited, any alteration in land supply is important. The land speculator gambles that if his land is withheld from the market long enough the resulting shortage will force the value up to a profitable level.

Although there is insufficient data to determine statistically the impact of land speculation on land values at Lake Tahoe it is important to note that the Tahoe Basin is considered a high land cost area in spite of

30,000 vacant lots. The following excerpt from the 1971 TRPA Housing Study postulates the causes of high land costs:

> 1. The relative scarcity of usable, accessible, buildable and serviceable properties.
> 2. The preponderance of public ownership in the Basin.
> 3. The "speculative" character of land investors who control some key parcels.
> 4. The additional cost burden, imputed to land for "special assessments" (mostly sewers) adding to land costs.
>
> Several examples will suffice:
>
> 1. Lots in the Tahoe Sierra Tract, filed in 1950-51, originally sold for $400-$500. By 1960 they were priced at $2500-$3000; today they average about $5000.
> 2. Lots in the Barton Tract (City of South Lake Tahoe) at the time of origin (1953) sold for about $1000; in 1960 they were priced at $3000. They are now approximately $6000.
> 3. A single family, lake front lot at Incline Village sold for $17,500 in 1960. They are now selling at $85,000.
> 4. Single family developed residential lots, practically anywhere in the Basin, now retail for approximately $1 per square foot. (Smith, 1971, p. 35)

Another common result of widespread land speculation is the creation of pressure on local government to rezone additional increments of land for urban purposes. Land is usually sold on an option basis contingent on the buyer's ability to secure a favorable (i.e., urban) zone change. (The above discussion on speculation impacts is based on a personal interview with John Bihary, real estate appraiser, July 1973.)

Lake Tahoe is especially vulnerable to this phenomenon because the supply of land is limited and the demand for subdivided lots is greater than the demand for lots with structures. The recent trend toward more intensive land uses (e.g., condominiums), while areas remain vacant which had been subdivided several years previously, may be a consequence of this. If so, the local land use policy permitting these more intensive uses can be traced directly to local government's earlier planning decisions which sanctioned speculative holdings, thereby placing development pressure on the remaining land.

In 1970 the disparity between actual subdivided land and land indicated for development on the county general land use plans was in excess of 25,000 acres or roughly 39 square miles (see Table VII - 2). This disparity may be considered evidence of a pro-development bias. These plans, which show an excessive amount of acreage available for housing, provided the conceptual pattern for all land development through 1971.

COUNTY	APPROVED SUBDIVISIONS	INTERIM PLAN AVAILABLE FOR SUBDIVISION	EXCESS ACRES
El Dorado	10,750	14,730	3,980
Placer	5,910	22,800	16,890
Douglas	2,040	5,310	3,270
Washoe	3,490	4,880	1,390
TOTAL	22,190	47,720	25,530 40 sq. mi.

Table VII - 2: COMPARISON OF APPROVED SUBDIVISION ACREAGE AND GENERAL PLAN (INTERIM PLAN) ACREAGE (1970).

Source: Hand counted (July 1973) subdivision approvals matched with TRPA 1"=400' scale maps (1970) and the TRPA Interim Plan 1970 as compiled in U.C. Santa Cruz Data Bank.

The Transition from Local to Regional Planning

The apparent inability of local government to regulate private land uses consistent with conserving the region's high scenic values has been documented above. This concern, though, is perhaps best demonstrated by the intense interest in coordinated, Basin-wide planning which has existed since the mid-fifties at Lake Tahoe. A summary of this interest and a discussion of the difficult transition from local to regional planning follows. (This discussion is developed primarily from Appendix A. Except where noted, the source is "Lake Tahoe," the newsletter of the Lake Tahoe Area Council).

The need for a regional approach to land use was recognized in the late 1950's. In 1958 a Tri-County Planning Commission was formed in Nevada, and a Bi-County Planning Commission in California. These advisory commissions became the Tahoe Regional Planning Commission (TRPC) in 1960. Funds, staff, and formal powers were insufficient to actively pursue a substantial planning program. In the early 1960's a private grant provided funding for the preparation of a "1980 Regional Plan," developed by the San Francisco Bay Area firm of Wilsey, Ham and Blair (Wilsey, Mann, 1964). This plan was adopted by the TRPC and various county planning commissions in 1964. However the Boards of Supervisors of the Tahoe Basin counties did not adopt the 1980 Plan and land use regulation continued under the provisions within county general plans.

California and Nevada became active in the Tahoe Basin land use issue in 1964, through the creation of a Joint Study Committee charged with the responsibility of investigating the feasibility of regional government in the Tahoe Basin. The Committee's report, completed in 1967, recommended a Bi-State Regional Agency with extensive land use control authority. Considerably weaker versions of the proposed Bi-State Agency were approved by California in 1967, and by Nevada a year later. In 1969 the Bi-State Planning Compact was signed by Congress, creating the Tahoe Regional Planning Agency (TRPA).

The TRPA convened its first meeting in April, 1970, as the staff and governing body began preparation of a regional plan. Adoption of an interim regional plan within ninety days of the initial convening of the TRPA was mandated by the compact. As a result of severe time pressures and data gathering constraints, an unaltered composite of the existing local general plan maps was presented and adopted. This interim plan became the basis for all TRPA approvals of land development during the following two years.

Lands designated on the interim plan for urban, semi-urban and rural estate development totaled nearly 48,000 acres or roughly 75 square miles (staff calculations, from TRPA Interim Plan, 1970). Using population density figures developed for TRPA use districts (TRPA General Plan, 1971) the population potential of the interim plan is calculated to be over 395,000 persons, based on assumed 80% build-out and 80% occupancy rates (see Table VII - 3).

LAND USE CATEGORIES	ACRES	PERSONS/ ACRE	POPULATION	@ 80% BUILD OUT 80% OCCUPANCY
Rural Estates	11,110	.5	5,550	3,552
Residential Estates	4,210	5	21,050	13,472
Low Residential	24,420	10.5	256,410	164,102
Medium Residential	1,630	20	32,600	20,864
High Residential	1,980	37.5	74,250	47,520
Tourist Commercial	1,830	60	109,800	70,272
Limited & Local Com.	670	30	20,100	12,864
General Commercial	1,290	50	64,500	41,280
TOTAL	47,140		584,260	373,926

Table VII - 3: INTERIM PLAN LAND USE ACREAGE POPULATION CAPACITY

Source: TRPA Interim Plan; computations from UCSC Tahoe Data Bank

It is clear that major environmental degradation was likely to occur from the impacts of residential and commercial construction, expanded highway networks, enlarged sewage disposal systems, etc., needed to support and service this large population. The TRPA staff recognized the potential impact of these previous planning commitments, although a clear environmental planning strategy was not formulated (Pepper, 1971).

The TRPA staff clashed repeatedly with governing body members, and members of the TRPA Advisory Planning Commission (APC) (whose membership included the planning directors of the local governments under TRPA authority) over approvals of proposed land developments. (U.S. Senate, 1972a; Agena, 1972; and Bronson, 1971.) Local government officials were understandably concerned that their authority was being undercut by the TRPA. Conflicts between these two levels of government were common.

Permit review occupied the majority of staff time as the eighteen-month planning period mandated by the Bi-State Compact slowly elapsed. Although a series of citizen technical committee reports was prepared (TRPA, 1971; 1971n, inclusive), the TRPA staff lacked sufficient personnel, time, and information to engage in an active planning process (Pepper, 1972).

In 1970 the U.S. Forest Service established a special Tahoe Basin Planning Team to develop plans and policies for the public lands in the basin. This team subsequently provided the environmental research support for preparation of the TRPA Plan. Working in conjunction with a research group in the Department of Landscape Architecture at the University of California at Berkeley, the USFS team conducted an extensive analysis of the dynamics of the Tahoe Basin landscape.

As a result of this research, the USFS team was able to define seven Land Capability Districts, based on the relative tolerance of the landscape to absorb land development without sustaining permanent damage. These districts are primarily defined in terms of the following characteristics of the landscape: slope, soil erosion, runoff, drainage density, revegetation potential, flooding, wildlife, sedimentation and water quality (U.S. Forest Service, 1972).

Conservation groups made several unsuccessful attempts to secure a development moratorium on all Basin lands during the planning period. However the only moratorium envoked was a HUD-FHA moratorium on all FHA mortgage insurance activity in the Tahoe Basin.

The APC and the TRPA governing body continued to give wholesale approval to land development proposals over the constant objections of conservation-minded members of the respective bodies (Brandt, 1971; Bronson, 1971). In addition, hundreds of units were approved in spite of negative TRPA staff recommendations which were based on analysis of slope and soil conditions. (Pepper, 1971).

The Bi-State Compact required that public hearings on the regional plan be held at the end of the eighteen-month planning period. In response to this legislative mandate, the TRPA regional plan was presented in June of 1971. This plan, usually referred to as the "staff plan," was developed by assigning specific land uses and a persons-per-acre factor to the USFS designated Land Capability Districts. This process produced an unusual land use plan based wholly on ecological factors and yielded a theoretical maximum basin population of 136,000 persons.

Unfortunately, the staff plan failed to provide for existing development or paper subdivisions! These additional land uses would have allowed a potential population of about 300,000 persons, if the same persons-per-acre factor were used. Current estimates of peak-day populations were also excluded from population calculations.

Conservationists were naturally elated at the prospect of a strong, environmentally based plan which included the returning of large areas of existing development to a natural state.

Amidst growing controversy, however, political realities prevailed and the "staff plan" was shelved by the governing body in early July. The TRPA then appointed an APC Subcommittee to prepare a politically feasible regional plan within two months. This subcommittee was composed of the six local planning directors whose planning authority within the Tahoe Basin had previously been pre-empted by the TRPA.

Meanwhile, a Bureau of Outdoor Recreation draft study released in August recommended sweeping changes in the structure of the TRPA in order to realize the environmental goals mandated by the legislation (Bureau of Outdoor Recreation, 1971). The controversial report was never made public, and the TRPA continued on schedule toward plan adoption.

Extensive hearings on the completed APC subcommittee plan were held in September and October 1971. Conservationist pressures eventually convinced the APC and the TRPA governing body that the regional plan would not meet the legislative mandate unless land use was regulated on the basis of the USFS Land Capability Districts.

The result was a two-map plan; with permitted land uses determined by the APC subcommittee plan and the use intensity (expressed as a percentage of land coverage) regulated by the seven previously designated land capability districts (U.S. Forest Service, 1972). Adoption of this unique two-map plan was subsequently delayed by the Nevada TRPA members who requested the preparation of an Environmental Impact Statement on the proposed plan (see Section IV; Figure IV - 1).

TRPA Land Use Controls

The TRPA Plan, as adopted December 1971, is implemented through a land use ordinance enacted February 1972 (TRPA 1972a). This ordinance establishes regional land use districts and land capability districts; provides for both population density controls and land coverage limitations; and includes procedures for the issuance of permits and non-conforming uses.

It is not surprising that a concept of land capability districts became the environmental quality dimension of the plan. The enabling legislation had charged the agency with the preparation of "regional plan of resource conservation and orderly development (and) to exercise effective environmental controls" (U.S. Congress, 1969).

The land capability districts were matched in the ordinance with corresponding land coverage limitations on areas with high susceptibility to development disturbances. The relative distribution of these districts and the percentage of land coverage permitted is delineated in Table VII - 4 (TRPA 1972a, p. 12).

LAND CAPABILITY	DEVELOPMENT RISK	DISTRIBUTION IN LAKE TAHOE BASIN (ACRES)				PERCENTAGE OF LAND COVERAGE PERMITTED [1]
		TOTAL BASIN		NATIONAL FOREST LANDS		
1	high	148,750	74%	102,266	88%	1%
2		4,770	2%	2,012	2%	1%
3		12,900	6%	3,472	3%	5%
4		7,050	4%	1,421	1%	20%
5		16,730	8%	4.878	4%	25%
6		8,000	4%	1,444	1%	30%
7	low	3,030	2%	101	1%	30%

Table VII - 4: TRPA LAND CAPABILITY DISTRICTS

Source: TRPA and USFS Land Capabilities Planning Guide Map

[1] TRPA Land Use Ordinance

The land coverage constraints set forth in the ordinance do not apply to all land uses. One exception is pre-existing lots (i.e., subdivisions approved prior to plan adoption) in residential subdivisions which are allowed coverage considerably in excess of designated land capabilities, and pre-existing lots and parcels in medium and high density residential districts which are granted 35% and 50% land coverage respectively. More significant are the land coverage provisions permitted for commercial development. Tourist commercial land uses are permitted 35 to 50% land coverage and general commercial land uses may have up to 70% coverage; these provisions apply to all land designated for commercial uses regardless of the land capability.

The implications of these exceptions are clear; the TRPA Plan, generally thought to provide substantial environmental controls, merely places highly restrictive land coverage limitations only on new residential subdivisions while permitting and encouraging higher intensity uses in existing and new commercial areas, and in medium and high density residential districts that contain existing subdivided lots.

Adoption of the TRPA General Plan resulted in major incongruences with previous land use decisions (Pepper, 1972). A number of remote and unbuilt-upon subdivisions were reclassified for General Forest uses. This designation prohibited the construction of residential units. Many existing subdivisions with varying degrees of residential buildout were placed within very restrictive land capability districts.

However, the most dramatic changes were in the reductions of acreages within high use potential districts as delineated on the existing County General Plans (TRPA Interim Plan). Table VI$_I$-5 shows acreages of specific land use district removed from each county allocation in the TRPA Plan. Of note is the 46% reduction of urban uses, primarily in residential categories.

	COUNTIES (ACRES)				
CATEGORIES	PLACER	EL DORADO	DOUGLAS	WASHOE	TOTALS
RURAL ESTATE RES. ESTATE OVER 1	-12,650	-20	-1,240	-840	-14,750
LOW RESID. 1-3 DW/AC	-1,230	-4,070	-500	-460	-6,260
MED. RESID. 4-8 DW/AC	+140	+420	-610	+90	-40
HI RESID. 8-15 DW/AC	-160	+490	+110	-150	+290
TOURIST COMMERCIAL	-30	-100	-250	-110	-490
LIMITED OR LOCAL COMM. GENERAL COMMERCIAL	-490	+410	-70	-80	-230
SERVICE INDUSTRY	+190	+100	-40	+80	+330
COUNTY TOTALS	-14,230	-2,770	-2,600	-1,470	-21,070

Table VII - 5: LAND USE DISTRICT ACREAGE NET CHANGES UNDER TRPA PLAN -- TALLY BY COUNTY

Source: TRPA Interim Plan; Computations from UCSC Ta[illegible] Data Bank

Although the California counties have a considerably greater endowment of high capability lands than those in Nevada, the acreage reductions were also of major proportion. Of the 18,390 acres removed from high capability uses, some 13,780 acres (75%) were in California. El Dorado County and the City of South Lake Tahoe had 4650 and 3690 acres removed respectively. Also the major commercial area acreage reductions were made on the California side, pointing up the reluctance of the Nevada interests to compromise commercial and gaming interests.

TRPA Concern for Wastewater Management

A similar comparison can be made using wastewater management districts as the units of observation (Table VII -6). Nearly 12,000 acres within sewerage districts have been removed from urban uses by the TRPA Plan. As expected, California districts experienced the greatest reductions.

CATEGORIES	NTPUD	TCPUD	STPUD	IVGID	WSID#1 CB	TD,RH,K,EP & D GID	TOTALS
RURAL ESTATE RES. ESTATE OVER 1	-290	-2,900	-10	-880	0	-1,150	-5,230
LOW RESID. 1-3 DW/AC	-280	-1,940	-2,640	-320	-70	+470	-5,650
MED. RESID. 4-8 DW/AC	+50	+100	+410	+110	-50	-530	+140
HI RESID. 8-15 DW/AC	-100	-250	+700	-140	0	+40	+250
TOURIST COMMERCIAL	-20	-90	-80	-100	+10	-210	-500
LIMITED OR LOCAL COMM. GENERAL COMMERCIAL	+60	-290	+410	+20	-40	-70	+130
SERVICE INDUSTRY	+10	+50	+100	+80	0	-40	+200
DISTRICT TOTALS	-570	-5,320	-1,110	-1,230	-150	-2,430	-10,660

Table VII - 6: LAND USE DISTRICT ACREAGE NET CHANGES UNDER TRPA PLAN -- TALLY BY WASTEWATER MANAGEMENT DISTRICT

Source: TRPA Interim Plan; Computations form UCSC Tahoe Data Bank

During the hearings on the proposed TRPA Plan, a number of objections were voiced by various special districts. It was claimed that the plan effectively limited the growth of service areas; thereby reducing revenues and producing fiscal problems for the districts. However, a study of the economic impact of the TRPA Plan on special districts did indicate that the effects of the plan itself would produce few fiscal problems (Baxter, McDonald 1971).

Sewage disposal systems were not a central consideration in the development of the 1971 TRPA Plan. Reports and studies prepared for the agency in the areas of wastewater collection, treatment, and disposal are too generalized and fail to provide sufficient information for region-wide decision making.

The 1971 TRPA Wastewater Committee Report consists mainly of assorted, one-time and non-parallel statistics as reported by sewerage districts (TRPA, 1971m). The "Lake Tahoe Water, Wastewater and Drainage," (HUD-701 Draft Study) (Walters Engineering, 1973) also fails to provide an information base to assist the TRPA in coordinating land use and wastewater management. Nor are the conclusions and recommendations reached in the study supported by strong quantitative data. Unless the final report is a substantial improvement over the draft study, the TRPA will continue to conduct its planning program without an understanding of the influence and impact of wastewater management in the Basin.

SECTION VIII

OVERVIEW AND PROSPECT

The complexity inherent in the research topic required a constant shift in the analysis between general contextual factors and specific relationships. Section IV and V addressed the general considerations of environmental quality, land use and development, and wastewater management in the context of the Lake Tahoe Basin. In Secion VI specific quantitative and structural relationships were analyzed, and Section VII presented an analysis and evaluation of the wide range of public policies contributing to the evolution of the land use pattern in the Tahoe Basin.

The purpose of this final section is twofold: first, to provide an overview of the research findings through the presentation of a descriptive model of the land development process in the Tahoe Basin; and second, to discuss briefly the outlook for the Basin as built upon inferences from the model.

Descriptive Model

Conceptual Framework

The development of the descriptive model incorporates research findings from Sections VI and VII and two previously developed models: the Environmental Quality Land Use - Wastewater Management model illustrated in Figure III - 1 (page 8); and the Conceptual Model of the Land Development Process shown in Figure V - 6 (page 28).

Since major structural changes have occurred in the land development process in the Basin, it is necessary to indicate important changes in the descriptive model to encompass the three periods of urbanization in the Tahoe Basin identified and discussed under Development Periods in Section V (see Table V - 1, page 30).

Although these periods delineate distinct stages in the evolution of the land development process in the Basin, it is the factors which influenced the transitions from one period to the next which are of primary importance in understanding the dynamics of the process.

Components

The Conceptual Model developed in Section V consisted of six primary elements: demand, activities, land use control, infrastructure, physical land development, and environmental change. Each of these elements is further defined by a set of discrete measures which are identified in Table VIII - 1.

ELEMENT	MEASURES
(1) Demand	Permanent Population Seasonal Population Transient Population
(2) Activities	Outdoor Recreation Land Subdivision and Development Legalized Gaming Other Commercial Tourism
(3) Land Use Control	Land Subdivision Residential Development Commercial Development Outdoor Recreation Facilities Development
(4) Infrastructure Development	Wastewater Management Transportation Water Supply Energy
(5) Land Development	Single Family Residential Multiple Family Residential Motel/Hotel Commercial
(6) Environmental Change	Water Pollution Scenic Degradation Erosion-Sedimentation Air Pollution

Table VIII - 1: DESCRIPTIVE MODEL ELEMENTS AND MEASURES

Structure

Since the Conceptual Model provides the basic structure for the descriptive model, it is repeated below as Figure VIII - 1 for ease of reference.

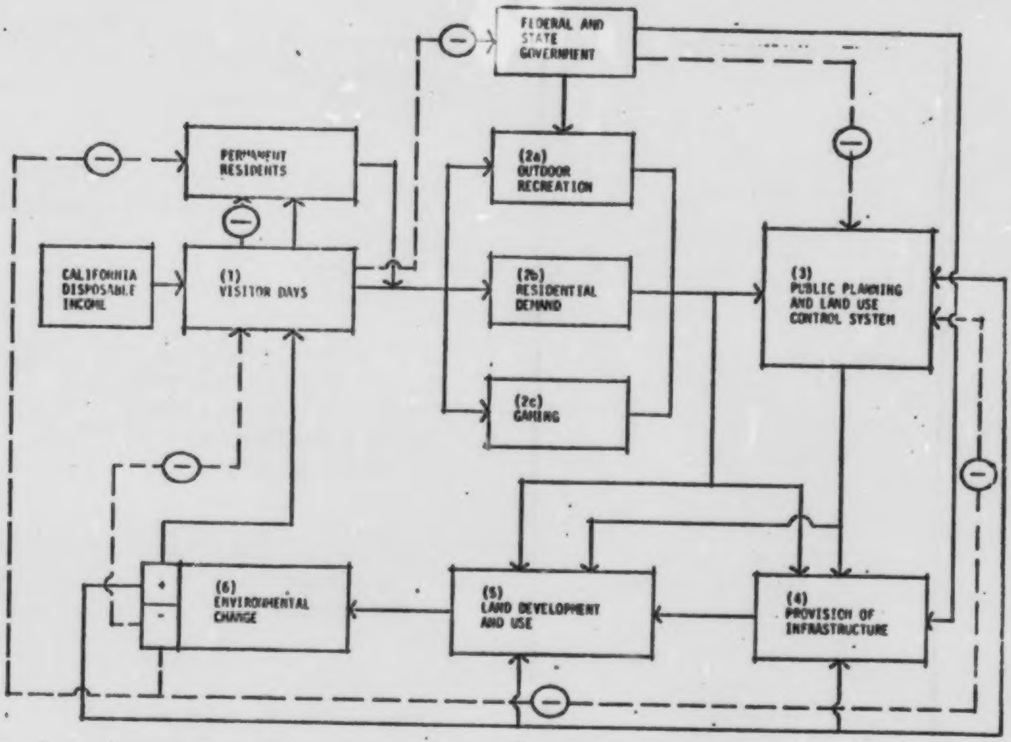
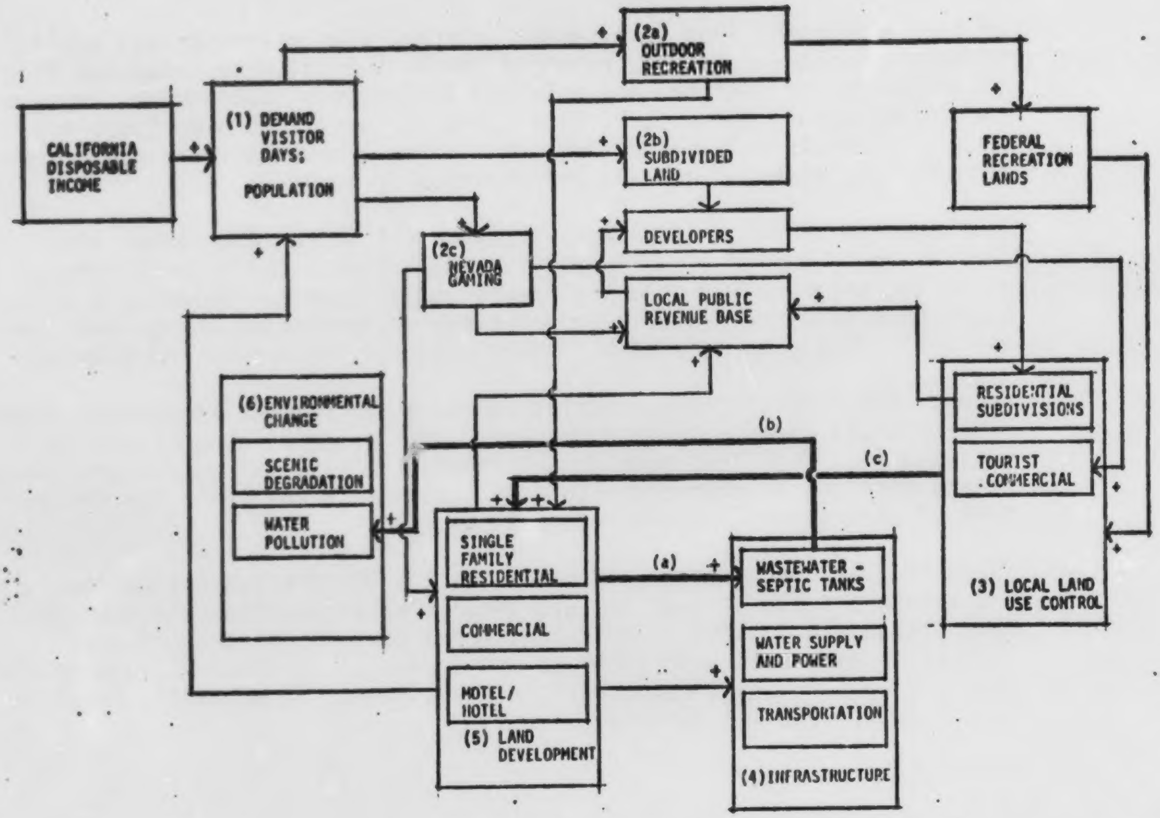

FEDERAL AND STATE GOVERNMENT
PERMANENT RESIDENTS
(2a) OUTDOOR RECREATION
CALIFORNIA DISPOSABLE INCOME
(1) VISITOR DAYS
(2b) RESIDENTIAL DEMAND
(3) PUBLIC PLANNING AND LAND USE CONTROL SYSTEM
(2c) GAMING
+
-
(6) ENVIRONMENTAL CHANGE
(5) LAND DEVELOPMENT AND USE
(4) PROVISION OF INFRASTRUCTURE

Figure VIII - 1: CONCEPTUAL MODEL OF THE LAND DEVELOPMENT PROCESS: LAKE TAHOE BASIN 1950-1972
Dashed lines indicate negative feedback

The detailed model structure was derived from the relationships established in Section VI and VII, thus providing the specificity necessary to expand and modify the relationships initially hypothesized in the Conceptual Model.

Period One: 1950-1959

All the relationships indicated in the initial period, 1950-1959 (Figure VIII - 2), are self-reinforcing, i.e., they display positive feedback and therefore constituted a development-sustaining process. None of the elements are linked through self-correcting mechanisms (negative feedback).


CALIFORNIA DISPOSABLE INCOME
(1) DEMAND VISITOR DAYS; POPULATION
(2a) OUTDOOR RECREATION
(2b) SUBDIVIDED LAND
(2c) NEVADA GAMING
DEVELOPERS
LOCAL PUBLIC REVENUE BASE
FEDERAL RECREATION LANDS
(6) ENVIRONMENTAL CHANGE
SCENIC DEGRADATION
WATER POLLUTION
SINGLE FAMILY RESIDENTIAL
COMMERCIAL
MOTEL/ HOTEL
(5) LAND DEVELOPMENT
WASTEWATER - SEPTIC TANKS
WATER SUPPLY AND POWER
TRANSPORTATION
(4) INFRASTRUCTURE
RESIDENTIAL SUBDIVISIONS
TOURIST COMMERCIAL
(3) LOCAL LAND USE CONTROL
(a)
(b)
(c)
+

Important elements and relationships in the pre-sewage treatment facilities period are as follows:

(a) land development utilization of septic tanks for wastewater disposal;

(b) water pollution resulting from septic seepage into Lake Tahoe; and

(c) lack of strong local land use control

Figure VIII - 2: DESCRIPTIVE MODEL -- PERIOD ONE: 1950-1959

In the Tahoe Basin land development process, when environmental quality thresholds were approached, negative feedback loops were generated through a combination of internal and external influences. Subsequent stages of the model include these corrective feedback loops. (Broken lines are used to indicate self-correcting conditions; arrows indicate causal relationships, although not all are empirically tested.)

Two negative feedback loops were instrumental in the transition from period one to period two (Figure VIII- 3). First, the adverse effects of septic water pollution on residents and on tourism (especially outdoor recreation) generated a loop between environmental change and demand, and subsequently to federal and state policies, programs, and grants.

Second, the size of gaming facilities and other commercial tourist establishments was clearly limited by septic tank disposal capacities. A negative loop from land development (commercial) to infrastructure (wastewater) resulted as commercial interests sought to influence the development of wastewater management facilities.

These feedback loops (shown in Figure VIII - 3) were central to the transition between periods one and two. (Two conventions are used to show changes in figures illustrating model periods and transitions: important changes in relationships are indicated by heavier lines in the figure in which they first appear; elements that are primarily involved in the transition are shaded.)

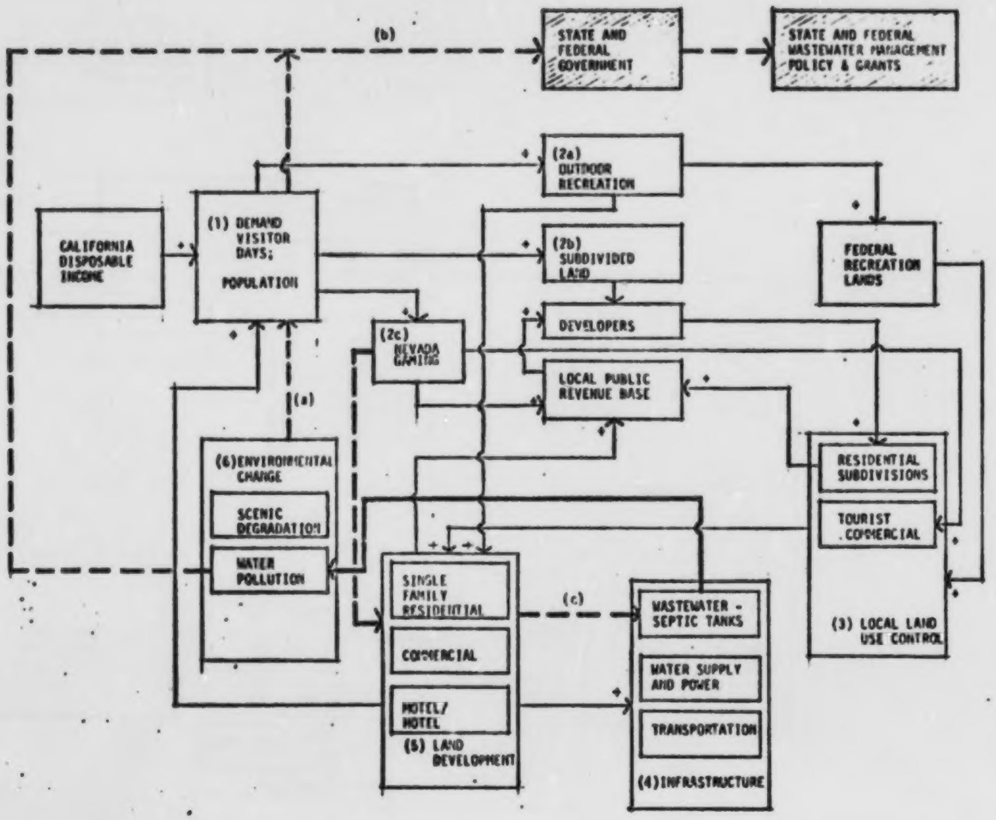
Period Two: 1960-1969

Figure VIII - 4 depicts the model for this period. Major expansion of wastewater facilities occurred in these years, permitting the growth of multiple-family residential and commercial-tourism developments. The provision of sewage treatment facilities also led to a substantial increase in the density of single family residential development.

These land use changes in turn produced undesired changes in environmental conditions; namely increased erosion, sedimentation and consequent turbidity of Lake Tahoe waters, and scenic degradation resulting from vegetation clearing. Furthermore these adverse changes were a potential threat to the tourism and recreation-based economy. Figure VIII-5 illustrates the resulting negative feedback loop generated between environmental change and demand, and subsequently between demand and federal and state policies, programs, and grants. It was this environmental quality feedback loop which led to the transition from local to regional land use control through the creation of the TRPA.

Period Three: 1970-Present

Although the formation period of the TRPA spans half a decade, 1970 marks the actual inception of regional land use planning and control in


(b)
STATE AND FEDERAL GOVERNMENT
STATE AND FEDERAL WASTEWATER MANAGEMENT POLICY & GRANTS
(2a) OUTDOOR RECREATION
CALIFORNIA DISPOSABLE INCOME
(1) DEMAND VISITOR DAYS; POPULATION
(2b) SUBDIVIDED LAND
FEDERAL RECREATION LANDS
DEVELOPERS
(2c) NEVADA GAMING
LOCAL PUBLIC REVENUE BASE
(a)
(6) ENVIRONMENTAL CHANGE
SCENIC DEGRADATION
WATER POLLUTION
RESIDENTIAL SUBDIVISIONS
TOURIST COMMERCIAL
SINGLE FAMILY RESIDENTIAL
(c)
WASTEWATER - SEPTIC TANKS
(3) LOCAL LAND USE CONTROL
COMMERCIAL
WATER SUPPLY AND POWER
MOTEL/HOTEL
TRANSPORTATION
(5) LAND DEVELOPMENT
(4) INFRASTRUCTURE
+

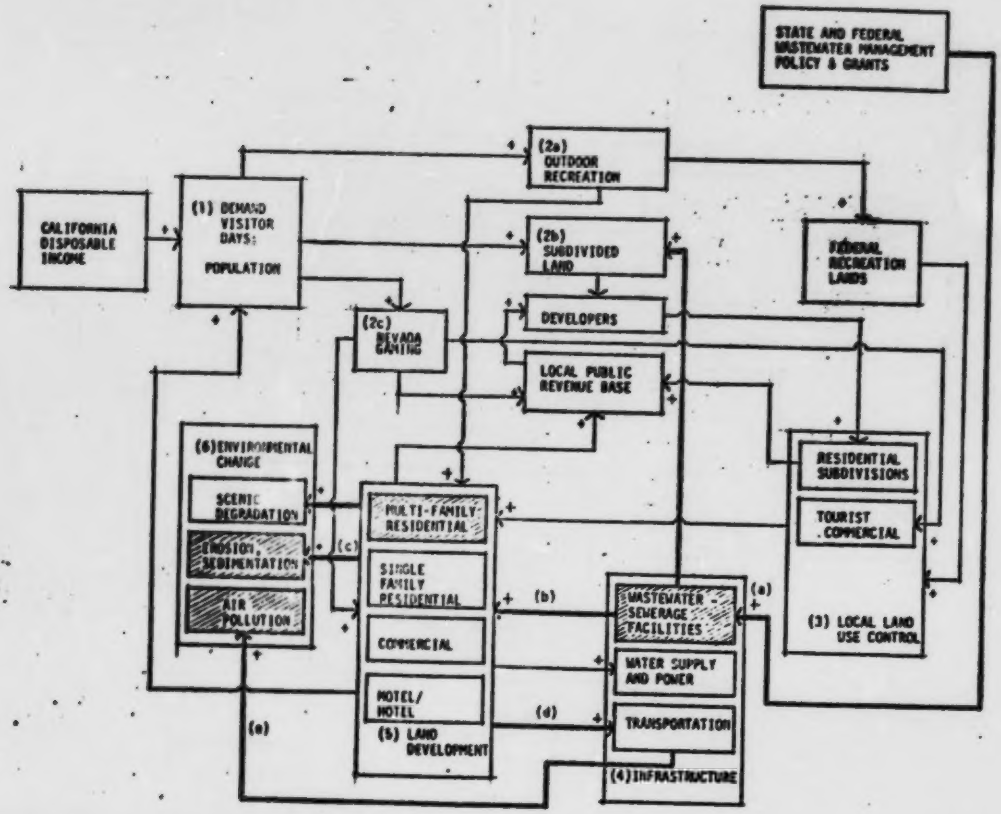
Important elements and relationships in this transition period are as follows:

(a) potential negative impact of water pollution on demand and visitor days;

(b) influence of water pollution on state and federal water pollution control programs; and

(c) development constraints (especially on commercial and gaming facilities) of septic tank disposal capacities.

Figure VIII - 3: DESCRIPTIVE MODEL -- TRANSITION: PERIOD ONE PERIOD TWO


STATE AND FEDERAL WASTEWATER MANAGEMENT POLICY & GRANTS
(2a) OUTDOOR RECREATION
CALIFORNIA DISPOSABLE INCOME
(1) DEMAND VISITOR DAYS: POPULATION
(2b) SUBDIVIDED LAND
FEDERAL RECREATION LANDS
DEVELOPERS
(2c) NEVADA GAMING
LOCAL PUBLIC REVENUE BASE
(6) ENVIRONMENTAL CHANGE
SCENIC DEGRADATION
EROSION, SEDIMENTATION
AIR POLLUTION
RESIDENTIAL SUBDIVISIONS
TOURIST COMMERCIAL
MULTI-FAMILY RESIDENTIAL
SINGLE FAMILY RESIDENTIAL
COMMERCIAL
MOTEL/ HOTEL
(5) LAND DEVELOPMENT
WASTEWATER - SEWERAGE FACILITIES
WATER SUPPLY AND POWER
TRANSPORTATION
(4) INFRASTRUCTURE
(3) LOCAL LAND USE CONTROL
(a)
(b)
(c)
(d)
(e)
+

Significant changes in both elements and relationships occurring during this period (defined by the provision of major wastewater treatment facilities) include:

(a) shift from septic tank disposal to sewerage treatment systems;
(b) growth in multi-family residential use;
(c) impact of land development on water quality (erosion and sedimentation)
(d) influence of land development growth on transportation; and
(e) impact of increased transportation on air quality.

Figure VIII - 4: DESCRIPTIVE MODEL -- PERIOD TWO: 1960-1969

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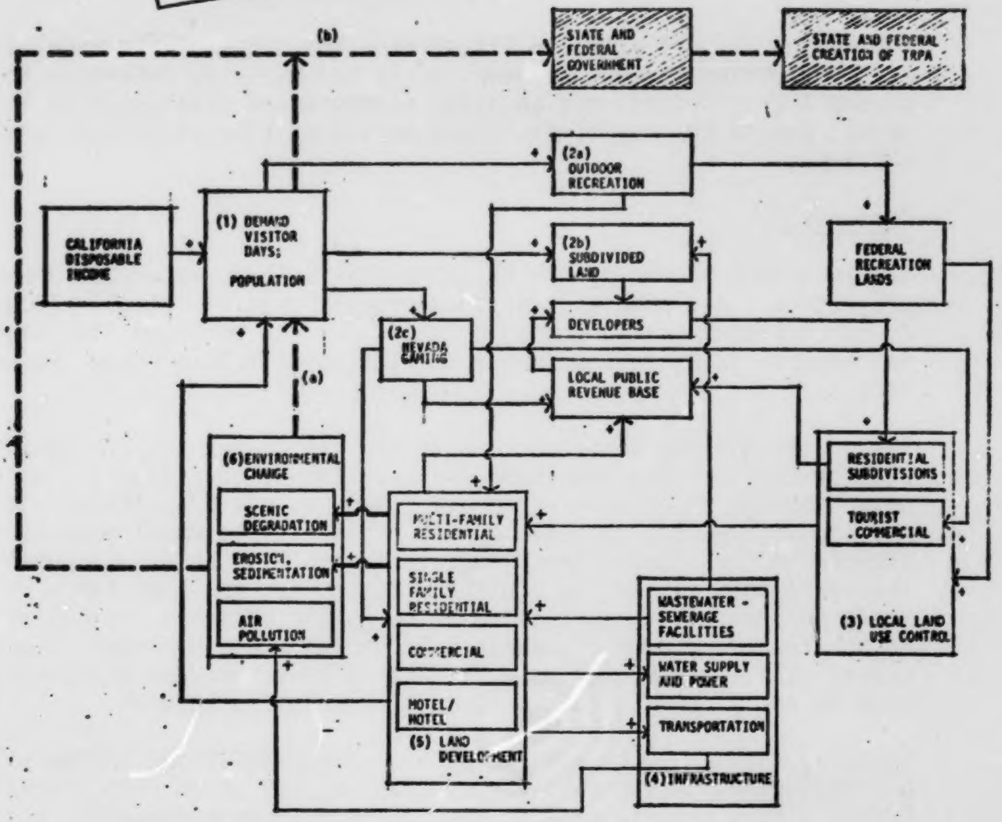

(b)
STATE AND FEDERAL GOVERNMENT
STATE AND FEDERAL CREATION OF TRPA
(2a) OUTDOOR RECREATION
CALIFORNIA DISPOSABLE INCOME
(1) DEMAND VISITOR DAYS; POPULATION
(2b) SUBDIVIDED LAND
FEDERAL RECREATION LANDS
DEVELOPERS
(2c) NEVADA GAMING
LOCAL PUBLIC REVENUE BASE
(a)
(6) ENVIRONMENTAL CHANGE
SCENIC DEGRADATION
EROSION, SEDIMENTATION
AIR POLLUTION
MULTI-FAMILY RESIDENTIAL
SINGLE FAMILY RESIDENTIAL
COMMERCIAL
MOTEL/ HOTEL
(5) LAND DEVELOPMENT
RESIDENTIAL SUBDIVISIONS
TOURIST COMMERCIAL
(3) LOCAL LAND USE CONTROL
WASTEWATER - SEWERAGE FACILITIES
WATER SUPPLY AND POWER
TRANSPORTATION
(4) INFRASTRUCTURE
+
-

Important elements and relationships in the second transition period are as follows:

(a) potential negative impact of adverse environmental changes on demand and visitor days; and

(b) influence of adverse environmental changes on State and Federal governments resulting in creation of TRPA.

Figure VIII - 5: DESCRIPTIVE MODEL -- TRANSITION: PERIOD TWO PERIOD THREE

the Basin. Figure VIII - 6 illustrates the state of the model at the start of period three. However, it is too early to determine the nature of the Agency's influence on other elements and relationships in the model, due to the relatively short period of time since the formation of the TRPA.

Prospect

Our knowledge of the future is extremely limited; accurate forecasts, projections, and predictions are difficult even for simple phenomena. In cases where social, economic, political and environmental factors are in constant interplay, accurate prediction of future change is extremely rare.

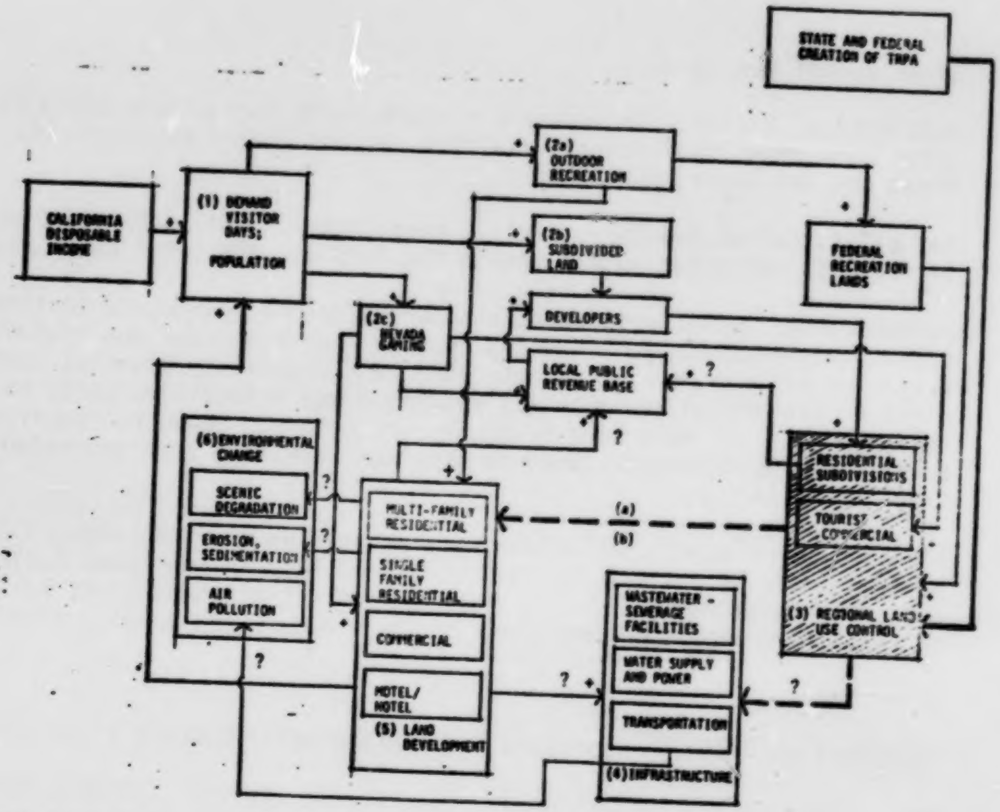
The uneven quality of research data and the consequent limitations of the statistical analysis precluded the development of a simple predictive method set forth as a research aim. However the dynamics of the land development process delineated by the descriptive model suggest that major changes in the process are primarily a result of shifts in public policy. Therefore this discussion on the prospect for the Lake Tahoe Basin is based on possible changes in selected public policies. Potential changes in the land development process will be described by means of brief scenarios. These scenarios are meant to serve only as examples, and as such do not provide a complete range of possible futures.

Existing public agency activities and responsibilities in the planning and management of the Lake Tahoe Basin suggest seven policy areas which have a direct relationship to the land development process: wastewater management, storm runoff, water supply, transportation, energy, land use control and public recreation. The likely impacts of hypothetical policies are discussed for each of these areas. As such, the discussion serves to illustrate potential changes, to determine their probable occurrence. In addition, the relationships among the hypothetical policies are not discussed, although this suggests numerous possibilities.

Wastewater Management

Hypothetical Policy: Increase wastewater treatment capacities of existing facilities within the Tahoe Basin.

Regardless of the basis for expansion, any additional capacity would very likely produce an adverse impact on the land use pattern designated on the TRPA Plan, particularly in terms of pressure to expand the urbanization limits onto lands in high-capability districts but zoned only for general forest uses. Conflicts of this nature have already been identified in an Environmental Impact Statement prepared for a proposed TTSA project. In addition, increased facility capacity would create an incentive to increase land use intensity, with the resulting pressure to increase land use densities permitted under the TRPA Plan.


STATE AND FEDERAL CREATION OF TRPA
CALIFORNIA DISPOSABLE INCOME
(1) DEMAND VISITOR DAYS; POPULATION
(2a) OUTDOOR RECREATION
(2b) SUBDIVIDED LAND
(2c) NEVADA GAMING
DEVELOPERS
LOCAL PUBLIC REVENUE BASE
FEDERAL RECREATION LANDS
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SCENIC DEGRADATION
EROSION, SEDIMENTATION
AIR POLLUTION
MULTI-FAMILY RESIDENTIAL
SINGLE FAMILY RESIDENTIAL
COMMERCIAL
MOTEL/HOTEL
(5) LAND DEVELOPMENT
WASTEWATER - SEWERAGE FACILITIES
WATER SUPPLY AND POWER
TRANSPORTATION
(4) INFRASTRUCTURE
RESIDENTIAL SUBDIVISIONS
TOURIST COMMERCIAL
(3) REGIONAL LAND USE CONTROL
(a)
(b)
+
?

The creation of the TRPA and the resulting land use controls introduced the following new elements and relationships:

(a) TRPA land capability districts control over-intensity of land development;

(b) TRPA land use district regulation of land uses; and

(c) changes in other relationships are presently indeterminate as the TRPA influence is still an unknown quantity (these relationships are indicated by question marks (?)).

Figure VIII - 6: DESCRIPTIVE MODEL -- PERIOD THREE: 1970-PRESENT

Storm Runoff Management

Hypothetical Policy: Incorporate a storm drain system into the wastewater management facilities, requiring a substantial expansion of treatment and export facilities.

Any additional wastewater capacity, regardless of the purpose and merits of facility expansion, would create the land use pressures noted above.

Furthermore, if the problems of erosion-sedimentation-eutrophication were effectively removed by channeling surface runoff through the wastewater treatment and export systems, the TRPA Land Capability District controls might be considered redundant as increased use intensities could be rationalized. If this were to occur, new controls would be required to address the environmental quality problems resulting from increased intensity of land use.

Although no research conclusions were reached on the influence of the holding costs on undeveloped but subdivided land in the Tahoe Basin, additional assessments for the treatment of storm runoff might well lead to sizeable economic consequences for land owners and special districts.

Water Supply

Hypothetical Policy: Reduction in Bi-State Water Compact allocations.

Water supply and distribution is potentially the most limiting factor in terms of future development in the Tahoe Basin. Any sizeable reduction in the water supply available for the operation of wastewater management facilities would have a profound influence on the form and spatial distribution of land uses in the Tahoe Basin. Furthermore, the export of wastewater and storm runoff could have serious effects on the amount of water flowing from the Lake for use by downstream residents.

Transportation

Hypothetical Policy: Upgrade Highway 50 to freeway standards and capacity.

An increase in the capacity of the primary California surface transportation link to the Basin would effectively remove an acknowledged constraint to development. Increased access is not an independent causal factor in the land development process, but rather it provides a vital component. Any substantial increase in infrastructure capacity has a corresponding influence on the land development potential.

Energy Use

Hypothetical Policy: Federal or State rationing of automotive fuel.

The regional economy is virtually dependent on tourism. Fuel shortages or prohibitive costs could cause an extended and substantial reduction in visitor days resulting in serious economic problems. Furthermore, if higher energy costs were to reduce projected urban growth in the Basin, special districts dependent on revenue bonds could encounter fiscal difficulty.

Land Use Control

The effectiveness of the TRPA is presently under challenge from two directions: those seeking to weaken substantially the Agency's land use control mechanisms, and those who claim the present controls are inadequate to meet the mandate of the Bi-State Planning Compact. The course will ultimately reconcile these opposing challenges, but decisions tending toward one extreme or the other would have a strong influence on the dynamics of land development.

Hypothetical Policy: Court ordered removal of Land Capability District land coverage controls.

Without the land capability constraints set forth in the TRPA Land Use Ordinance environmental problems associated with hydrology and vegetation could not be effectively controlled.

Hypothetical Policy: Court ordered stronger TRPA Land Capability Controls.

This would lead to tighter land use controls with a corresponding reduction in the population capacity of the TRPA Plan. The land development process would likely undergo two substantial changes under this policy. First, land costs would increase dramatically if the supply of land potentially available for development were significantly reduced thus raising serious equity questions; second, a re-distribution of taxes and special assessments would be required to sustain the existing level of public service investments. Landholders now unable to develop their properties would not be willing to pay taxes and assessments for services they could never utilize. Unless corresponding restitution policies were included to address the equity questions arising from this land use policy, environmental quality would be achieved at the social costs of forcing out low and middle income home owners. Service employees whose rent would be adjusted to cover readjusted taxes and assessment might be forced out of the Basin as well.

Recreation

Hypothetical Policy: Public lands in the Tahoe Basin developed to a maximum recreation potential.

If federal and state agencies pursued such a policy, the peak day and seasonal populations would increase tremendously. This population increase would in turn effect all infrastructure systems, public services, and commercial land uses, with consequent impacts on environmental quality. An ambitious public recreation policy would clearly have a direct and sizeable influence on the land development process in the Tahoe Basin.

Hypothetical Policy: USFS purchases or trades for parcels of land on which development would not be permitted under the TRPA Plan.

Any substantial reduction of private holdings will tend to increase development pressures on the remaining lands. Land values will rise since the land market has diminished in size and because of the larger open space amenity. Taxes will rise as well since the newly acquired public lands would be removed from the tax rolls. A higher density of development on remaining private lands would likely result.

The increased opportunities for recreation on the new public acquisitions would lead to pressure for more access, more sewage treatment capacity allocated to USFS lands, and more tourist facilities on private lands. The net effect might be a public subsidization of open space purchases which would primarily benefit private landholders in the Basin.

Summary

These scenarios indicate that while there is a potential myriad of interacting public policies to preserve Lake Tahoe, the future quality of the Tahoe environment is not especially secure. Clearly the role of the EPA, USFS and other federal and state agencies must be to consider the broadest possible policy implications of each single purpose action.

SECTION IX

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SECTION X

ABBREVIATIONS

APC -- Advisory Planning Commission
CAC -- City Annexation Commission
CEQ -- Council on Environmental Quality
CEQA -- California Environmental Quality Act
DWR -- Department of Water Resources
EIA -- Environmental Impact Assessment
EIR -- Environmental Impact Report
EIS -- Environmental Impact Statement
ERA -- Economic Research Associates
ESI -- Engineering Science, Inc.
FHA -- Federal Housing Administration
FWPCA -- Federal Water Pollution Control Act
FWQA -- Federal Water Quality Administration
GID -- General Improvement District
GPD -- Gallons Per Capita Per Day
HUD -- Housing and Urban Development
LAFCo -- Local Agency Formation Commission
LRWQCB -- Lahontan Regional Water Quality Control Board
LTAC -- Lake Tahoe Area Council
MGD -- Million Gallons Per Day
NEPA -- National Environmental Policy Act
NRS -- Nevada Revised Statutes
NTPUD -- North Tahoe Public Utility District
PUD -- Public Utility District
RWQCB -- Regional Water Quality Control Board
SID -- Sewer Improvement District
SPSS -- Statistical Package for the Social Sciences
STPUD -- South Tahoe Public Utility District
TCPUD -- Tahoe City Public Utility District
TRPA -- Tahoe Regional Planning Agency
TRPC -- Tahoe Regional Planning Commission
TTSA -- Tahoe Truckee Sanitary Agency
USFS -- United States Forest Service
WRCB -- Water Resources Control Board

SECTION XI

APPENDIX A

CHRONICLE OF INFLUENTIAL EVENTS AND DECISIONS: LAKE TAHOE BASIN 1950-1972

Any chronicle describing the events and changes since 1950 in the Tahoe Basin necessarily requires considerable selectivity and condensation. The purpose of this section is to describe the major events and decisions, both internal and external, which appear to have shaped the pattern of land use and the development of wastewater facilities to a significant degree. Those events and influences which relate directly to the central focus of research will naturally receive greater attention although secondary influences are described when appropriate.

The chronicle is divided into four parts: Evolution of the Land Use Pattern; Wastewater Management Policy, Planning, and Construction; Land Use Plans and Policy -- Local and Regional; and Exogenous and Endogenous Influences. Each describes events and decisions with a brief discussion of the type and scale of resulting influences. Unless otherwise noted, the source for events in this chronology is "Lake Tahoe," Vol. 1-8, official publication of the Lake Tahoe Area Council.

Evolution of the Land Use Pattern

As in the previous discussions of land use, the primary measures with available historical data are population, subdivision activity, building permits, housing, and measures of commercial activity. Where data is available the specific location of activity is also included.

1950 - 1954

By 1950 the Tahoe Basin population was estimated to be 2500 permanent residents, 5200 seasonal employees, 8100 seasonal recreationists, and 17,300 short-term peak day tourists. Thus, peak day population would have reached 31,600 in 1950 (Table VI - 8). The land use pattern was generally concentrated close to the shore on alluvium soils where septic tanks were easily constructed. In addition, highway access to and circulation around the lake served to encourage a land use pattern contiguous to the circulation systems, which generally parallel the lake shore. Approximately 75% of the highway system is within 1/2 mile of the lake shore with an additional 15% within the first mile, and the remaining 10% between one and two miles distance (staff calculations). This proximity of access quite naturally served to concentrate development close to the shoreline.

Subdivision approvals prior to 1950 had resulted in 17,500 single family residential lots within the Basin although only 5000 houses are estimated to have been constructed (Table VI - 9).

1955 - 1959

No population or housing data are available for 1955; however, an additional 3000 subdivision lots were approved, with 1800 lots, or 60% of Basin subdivision occurring in El Dorado County. Commercial and other urban services were very limited and tended to be spread along the North, Northwest, and South Shore highways, with little apparent concentration or planned urban structure. In 1959 an extensive real estate development, Tahoe Keys, was built on land fill which took place on the marsh lands at the Upper Truckee River lake inlet. This land fill removed the natural sediment filtration of the Truckee River provided by the marsh (California Resources Agency, 1969). The Upper Truckee is the largest lake tributary, and the loss of the marsh contributed significantly to increasing sedimentation and turbidity problems. Septic tank leach fields in this filled land would have quickly drained into the lake; obviously such a project could not have occurred without the availability of sewers.

1960 - 1964

The 1960 census count indicated 12,461 permanent residents, an increase of 398% over 1950 (Table VI - 8). In addition over 8500 new lots were approved -- nearly tripling the subdivision activity in the previous five-year period. Over 6500 of these new lots were added to El Dorado County, accounting for over 75% of the basin total. Housing counts in the 1960 census show 10,000 single-family units -- double the estimated 1950 count (Table VI - 9).

Seasonal and peak populations indicate differential rates of growth in permanent, seasonal, and peak populations. The peak day population is estimated to have been 93,000 and the seasonal population 38,000 (Table VI - 8).

In August of 1960 Washoe County, Nevada, adopted a master plan for Incline Village, a Boise Cascade major planned development. This approval in effect permitted a potential population increase of 30,000 residents in the region. It is significant to note that prior to this time, the scale of development was essentially controlled by the septic tank limitations of soils and geology. With the availability of sewerage treatment facilities this limitation was effectively removed and land developers could take advantage of economies of scale, thus increasing the size and intensity of development.

1965 - 1969

Housing and population data do not exist for 1965, thus subdivision approvals, building permits and commercial activity are the only available indicators of the evolution of the land use pattern. Subdivision activity during the period 1960-65 dropped significantly as 6500 lots were approved compared to 8500 during the previous five-year period. Of the lots approved, nearly one-half (3100) were in El Dorado County, and approximately one-third (2000) approved for the Boise Cascade Incline Village development in Washoe County (staff calculations).

The density of land use was increasing in the emerging urban centers in the Basin. In 1965 high-rise construction appeared and the first incorporated city, South Lake Tahoe, was established in the region. A study of urbanization of the Lake Tahoe Basin indicates that fifteen separate commercial centers can be identified in the region. These centers are concentrated along the perimeter highways, and during this period each increased in the number and type of services provided (Symonds, 1970).

1970 - 1972

The permanent population doubled between 1960 and 1970. The U.S. Census counts record a resident population of 25,000 in 1970. Estimates of seasonal and peak populations again vary dramatically but appear to average at 67,000 and 155,000 respectively (Table VI - 8).

A large increase in both subdivided lots and condominiums marks the period 1965-1970 (See Tables VI - 3 and VI -5). Over 13,000 residential lots were added to the Basin, plus building permits for over 3000 condominium and multiple family units. The actual increase in housing stock is difficult to determine due to reporting problems but by 1970 a total of 21,000 housing units were counted in the Tahoe Basin (including both single family and multiple family units (Table VI - 10)).

Commercial land uses also increased significantly between 1965-1970 as high-rise casinos, hotels, major shopping centers and motels became integral parts of the urban centers.

Wastewater Management -- Policy, Planning and Construction

This section traces the major events in treatment system expansion and seeks to highlight the sequence of policy decisions that shaped that expansion. (Unless otherwise noted, the information contained in this section was compiled from the LTAC newsletter and the Sewerage District offices.)

1950 - 1954

Wastewater treatment was confined to the use of septic tanks in the early years of Tahoe Basin development. The 1950's saw the beginning of centralized treatment. In 1953, the Tahoe City Public Utility District (formed in 1938 for the purpose of water service) obtained a California State loan to assist in the construction of a sewage collection, treatment, and disposal system. This system was completed and in operation by 1954, serving approximately 160 acres of development. In 1949, the North Tahoe Public Utility District was formed, although eight years elapsed until treatment facilities were completed in 1957. At the South Shore, the South Tahoe Public Utility District (STPUD) was formed in 1950, the design of collection and treatment was completed in 1952, and operation commenced early in 1956.

In 1953, the Douglas County (Nevada) Sewer Improvement District No. 1 (DCSID) contracted with STPUD to deliver the Nevada sewage to STPUD for treatment and disposal. This was done to avoid the high cost of constructing two completely separate systems (Brown and Caldwell, 1959).

1955 - 1959

A California-Nevada Interstate Compact Commission was established in 1955 to determine water allocations in the California-Nevada Sierra basins. Two years later an "unofficial" Tahoe Basin population projection was developed by the California Department of Water Resources (DWR) for the Interstate Compact Commission. The publication, "Lake Tahoe Population and Water Use Survey," dated April 30, 1957 included population projections from 1960-2010. The projections have proven to be significantly larger than the actual rate of population growth in the Tahoe Basin, and although the DWR publication was an in-house document, it became the basis for calculating plant capacity for all treatment plants designed between 1963 and 1967.

A Federal Water Pollution Control Administration grant for treatment plant construction was awarded to the NTPUD in 1957, marking the beginning of direct federal involvement in wastewater management in the Tahoe Basin.

A second population projection indicating extremely rapid growth rates for the Tahoe Basin was developed by the Reno Field Office of the U.S. Department of Commerce in 1959. This projection was similar in magnitude to the 1957 (and 1959 update) California DWR projections, indicating 248,000 persons in 1970 and 313,000 by 1980.

In 1959 a $250,000 FWPCA Grant was awarded to STPUD for assistance in construction of a 2.5 MGD secondary treatment plant. In addition, a major report for STPUD prepared by the engineering firm of Brown and Caldwell on Collection, Treatment and Disposal of Sewage in the South Tahoe Area, briefly discussed (but chose not to recommend) the alternative of pumping effluent out of the Tahoe watershed.

The alternative of disposing of treated sewage in the lake was also briefly discussed but emphatically rejected for several reasons: the probable impact of permanent degradation of the lake through eutrophication; the possibility of raw sewage entering the lake during treatment plant outages, and a resultant pollution of recreational beaches; the hazard of setting an undesirable precedent; and the disagreeable implications, at least in an aesthetic sense, of the presence of sewage outfalls. By rejecting both direct discharge into the lake and export, as well as deep well injection, the only practicable alternative left was that of land disposal through spray irrigation (Brown and Caldwell, 1959).

1960 - 1964

In November of 1961, the Lake Tahoe Area Council, through a $125,000 grant from the Max C. Fleischmann Foundation of Nevada, employed Engineering Science Inc., of Arcadia, California, to furnish engineering and scientific services for a Lake Tahoe sewage engineering study. A special blue ribbon board of wastewater management consultants was also appointed to direct and supervise the study, "one of the most comprehensive engineering studies of its kind ever undertaken in the United States." (LTAC, Vol. 3, no. 11, p. 1)

It is interesting to note that the announcement of the study followed a threatened"cease and desist" order in September, issued by the Lahontan Regional Water Pollution Control Board against the STPUD. This notice to issue a "cease and desist" order claimed 2 million gallons of treated effluent had been released from the district's holding ponds following the Labor Day holiday weekend. Such a release constituted a violation of the board's requirements prohibiting discharge of sewage or sewage effluent into Lake Tahoe or its tributary streams. Sewage and land use had clearly become the major planning issues at Lake Tahoe by 1961.

The sewage issue in the Lake Tahoe Basin accelerated in 1962. California Governor Brown urged bi-state basin-wide coordination on wastewater projects after Nevada approved construction of a community sewage system at Elk Point involving large-scale ground disposal of effluent within a few thousand feet of the lakeshore. The Governor's concern stemmed from consultant reports that ground disposal would not keep sewage effluent from entering the lake. A month earlier the California-Nevada Interstate Compact Commission had agreed to the export of sewage wastewaters from the Basin if and when the two states succeeded in reaching agreement on the water compact (already under negotiation for more than five years).

Water pollution problems had begun to mount during the winter months at the South Shore where large accumulations of frozen effluent at the treatment plant posed a threat in the event of a rapid thaw and runoff. By May the threat had become fact. The South Tahoe system was faced with a "cease and desist" order as the melting and runoff of frozen effluent, combined with unseasonally heavy sewage loads, had resulted in seepage into Heavenly Creek and the Upper Truckee River. Temporary measures eventually averted major discharge into the lake. Public concern had not however reached a point of action; local property owners defeated two sewage facility bond issues in 1962, one for plant expansion, the other for acquisition of additional lands for facilities. At the North Shore, the Nevada Bureau of Environmental Health approved a 1,000,000 GPD ground disposal site for Incline Village, thus further expanding the sewage disposal controversy.

The intensive wastewater study commissioned by LTAC in 1961, destined to influence both the immediate and future land use pattern, was presented publicly in June of 1963. The report, titled, Comprehensive Study on Protection of Water Resources of Lake Tahoe Basin Through Controlled Waste Disposal, concluded that the tertiary treatment of sewage wastes to "drinking water" standards and the final disposal of the highly refined effluent to the Truckee River Basin would provide the most feasible method of resolving the Lake Tahoe sewage problem and give positive protection against pollution of lake waters.

September of 1963 was marked by a visit from the Presidentially appointed Water Pollution Control Advisory Board who consulted with other federal, state and local officials on the Basin's sewage disposal problems and pollution prevention programs. Federal involvement in Basin sewage problems had grown slowly during the early 60's, and this 1963 meeting may well have served notice of an expanding federal role.

The following year was marked with a burst of activity in four of the special districts involved in the provision of sewage facilities. South Tahoe, Tahoe City, North Tahoe, and Douglas County, SID #1 were all involved in studies for annexations or expanded treatment plants as the pace of wastewater management programs accelerated. A grant from the Fleischmann Foundation to Placer County provided for funds to study export from the North Shore, while STPUD commenced work on a tertiary treatment plant.

In a major pronouncement in that same year, the Governors of California and Nevada issued a Joint Program for Progress at Lake Tahoe which adopted as a goal the export of wastes recommended by the 1963 Comprehensive Study.

1965 - 1969

The growing number and complexity of sewage disposal issues makes a comprehensive description of events difficult at best. For example, in 1965 South Tahoe PUD activities included: receipt of an FWPCA demonstration grant; an LRWQCB injunction against STPUD; passage of a 1.4 million dollar revenue bond for tripling existing capacity (September); LRWQCB approval for export of tertiary effluent to Hope Valley (September); LRWQCB cease and desist orders (October); and three annexations containing more than 4200 acres. This scale of activity was characteristic of sewage district operations during the period 1965-1970. Therefore, the balance of this chronicle will eliminate all but the most significant activities of individual districts.

At the request of the Secretary of the Interior, the States of California and Nevada and the FWPCA met at Tahoe in July of 1966 in a Conference in the Matter of Pollution Control of the Interstate Waters of Lake Tahoe. The Conference concluded that although the lake was not polluted or contaminated, there were recognizable threats of pollution due to the nutrients in effluent from municipal sewage treatment plants, residential septic tanks, and in refuse and garbage transported into the lake by surface drainage and subsurface seepage. Nutrients contained in sediment both from increased run-off and from erosion due to land alterations were also cited as threats to water quality. This passing observation later became central to the designation of the land capability districts developed in the TRPA plan. Major recommendations which came from the conference were that: all wastewater receive at least secondary treatment; all wastewater be exported from the Basin by 1970; all solid waste be exported from the Basin by 1970; and a Basin-wide agency with adequate powers to control land development be established. The question of export and disposal of treated waters into the Carson, Truckee and Walker River watersheds became a source of much controversy as citizens in those watersheds expressed grave concern over the adverse impacts of that policy on their own water resources.

Other 1966 events of significance include: a special session of the California Legislature called by Governor Brown to "do whatever is necessary to save Lake Tahoe"; an FWPCA grant to the Lake Tahoe Area Council for a study of eutrophication of Lake Tahoe ($296,500); an FWPCA demonstration grant to South Tahoe PUD; LRWQCB adoption of water quality control policy; and a North Tahoe PUD and Tahoe City PUD joint request for state aid in implementing sewage export for the North and West Shores.

In 1967 the water quality agencies of the two states completed their responses to the requirements of the Federal Water Pollution Control Act of 1965; California adopted an implementation plan for the Water Quality Policy it issued for the Basin in 1966 and Nevada promulgated water quality criteria and a plan of implementation for the whole state, including strict criteria for the Tahoe Basin. With FWPCA approval in 1968 the California and Nevada policies and criteria became State and Federal water quality standards.

By 1967 the direct federal investment in Lake Tahoe sewage facilities had grown to $2,300,000 including $770,000 in 1967 alone. In addition to construction grants, a $427,000 federal grant was awarded to the University of California at Davis to study the basic limnology of the lake and measure biotic productivity.

In 1968 an additional $6,500,000 in federal grants was committed for a variety of sewage projects in the Basin. That same year, the California Legislature adopted a 1970 deadline for sewage export (in 1969, however, the deadline was extended to 1972). STPUD, having planned for export earlier, began operation of its sewage export system in 1968, ushering in the present chapter in the management of wastewater at Lake Tahoe. In 1969 an additional $2,350,000 in federal grants was awarded to local districts, bringing the total federal commitment to over $11,000,000 in slightly over 10 years.

1970 - 1972

The Environmental Protection Agency was formed in 1970, incorporating the functions of the FWQA in the development and administration of federal water quality programs. The growing federal involvement in wastewater management at Lake Tahoe became the responsibility of the EPA who in 1970 approved over $950,000 in Tahoe Basin grants. One grant was awarded to the NTPUD for a pump station, the other to Incline Village GID to expand treatment facilities to 3 MGD of secondary treatment. In addition to the EPA grants, North Tahoe and Tahoe City PUD completed construction and commenced operation of jointly financed export to the cinder cone disposal site, and Incline Village GID expanded its treatment facility and began exporting secondary treated effluent over Spooner Summit to the Carson River. In April of 1970 the Nevada Bureau of Environmental Health placed a ban on use of septic tanks in Douglas and Washoe Counties in order to implement the established export policy.

The EPA granted $1,300,000 in 1971 to Tahoe City PUD and to the Tahoe-Douglas District for extensions of and additions to facilities. In addition to grant activities, the EPA as well as the LRWQCB were active in enforcement of water quality violations. The Lahontan Board also adopted an Interim Basin Plan to establish a framework for the water quality control effort in the Basin, and to meet the federal requirements for continued federal grant assistance.

In Nevada Governor O'Callaghan placed a ban on septic tanks on Nevada Basin land unless they were used in conjunction with holding tanks, and he ordered all effluent exported by December 31, 1972.

Land Use Plans and Policies -- the Shift from Local to Regional Control

Until the establishment of the TRPA in December 1969, all governmental land use decisions--planning and regulation--were a function of local governments. The growing land use issue focused directly on the ability of local governments to regulate private land uses consistent with conserving the great scenic values of the region acknowledged to be of national importance. This brief chronicle highlights the emergence of regional land use planning and regulation in the Tahoe Basin.

Growing concern over the lack of coordinated Basin-wide planning resulted in the formation in 1958 of parallel planning commissions in each state; the Tri-County Planning Commission in Nevada, and the Bi-County Planning Commission in California. These commissions lacked any formal powers and therefore served in advisory capacities only. However, in meeting together as a "regional planning commission," the need for coordinated regional level planning was explicitly acknowledged.

The two separate state planning commissions formally became the Tahoe Regional Planning Commission in 1960. However, lacking funds, staff, and formal powers and authority, the body remained merely an advisory body to the counties, although the planning directors of the various jurisdictions served on a Technical Advisory Committee to the Commission. In February of the following year Wilsey, Ham and Blair, a Millbrae, California planning firm, were selected to prepare a regional master plan (funded by a grant from the Fleischmann Foundation). The study, which would require 18-24 months to complete, was to include public services, an economic base study covering business, industry, finance and employment, population projections and distribution,water supply, sanitation, watershed protection, transportation, land values, education, and recreation.

Preliminary reports by Wilsey, Ham and Blair for their 1980 Plan studies indicated a pressing need for public facility land uses at Lake Tahoe in contrast to the current (1962) oversupply of residential lots which existed in the Basin. It is significant to note that the excess sites could accommodate a potential population of 78,000 persons. In addition, the projected population prepared by the consultants indicated a peak summer population of 418,000 by 1980, a figure considerably larger than either the DWR or U.S. Department of Commerce projections.

Hearings to review the regional plan were held during the summer of 1963, and in October the Tahoe Regional Planning Commission approved a final version of the plan. Plan document recommendations included: a system of scenic easements; establishment of single family residential density controls of 3.5 units/acre in order to preserve vegetation and ecological cover vital to the character of the lake; establishment of apartment densities of less than 15 families per acre, except in urban centers; establishment of very high standards for subdivision and development on steep hillsides; and map zoning districts to reflect precise plans at the county level. This version of the plan also indicated a significant reduction in the 1980 peak population--from 418,000 to 313,000 persons.

In July 1964 the regional plan was formally adopted by the TRPC. The significant decisions of the year, however, appear to be those leading toward a Basin-wide export of sewage. An additional decision of major proportion was a request by the TRPC for a Joint Study Committee, appointed by the state governments of California and Nevada, to study the feasibility of some form of regional government for the Tahoe Basin. California and Nevada lawmakers agreed in February of 1965 to conduct the bi-state study of regional government and appointed a nine-member committee to present their findings and recommendations by the end of a two-year period.

The Joint Study Committee Report was completed in 1967, recommending a Bi-State Regional Agency with extensive powers to strengthen rather than replace existing local governments. The agency would consist of a fifteen-member board with equal representation from state and local governments, and from local and non-resident interests. In addition, a non-voting member would represent federal interests. Following vigorous local objections and heated legislative debate the California legislature passed a bill (one of four introduced) creating a California Tahoe Regional Planning Agency. California Governor Reagan signed the bill; thus within the year California had created its half of the bi-state agency. During the same period Nevada Governor Laxalt left no doubt about his feelings. In a personal position paper he gave complete and unqualified support to a Tahoe Regional Agency. Governor Laxalt also stated he would call a special Nevada Legislative Session in 1968 to specifically take up the question.

Significant events of 1968 included both the signing of the California-Nevada Interstate (Water) Compact (which has not been ratified by Congress) and the signing into law of the Nevada Tahoe Regional Planning Agency. Both these decisions were the results of lengthy and exhaustive discussion, the water compact involving some 13 years of negotiation.

The following December after at least a decade of concern over the quality of land use planning and controls in the Tahoe Basin, President Nixon signed the Bi-State Planning Compact into law. The compact created the Tahoe Regional Planning Agency (TRPA), granting extensive regulatory powers to the eleven-member governing body. (Section VII of this report discusses the influence of the TRPA on land use, wastewater management, and environmental quality during the period 1969-1972.)

Exogenous and Endogenous Influences

The urbanizing of the Lake Tahoe Basin between 1950 and 1973 has been greatly influenced by factors outside the realm of land use and wastewater planning and development.

Population Growth

Population growth rates in California ranged from 2.7% in 1951 to 4.5% by 1957. The average increase for the 1950-1960 period was 4.0%. However, the rate of increase declined dramatically during the following ten-year period. The 1969 rate of increase was 1.5%, and the decade average was 2.7% per year (California Department of Finance 1969). Of particular relevance to the Tahoe housing market is the growth of families with incomes greater than$10,000 in the primary market area. This figure, 293,000 in 1960 grew to 598,000 by 1972--an increase of 102% (see Supplementary Appendix).

Gaming

In 1955 gaming casinos were established on a year-round basis at the Nevada state line, and the Tahoe Basin began to attract a growing visitor population based on the gaming and entertainment business. Although the direct spatial impact of this new land use was considerably limited, the indirect impacts on local traffic, housing and employment have grown to major proportions.

The increase in gaming in the Tahoe Basin can be best understood by observing the growth of gaming revenues in Douglas County. In 1956 five million dollars were generated in gaming revenues. By 1972 this had grown to 83 million, an incredible increase of 1500% over the seventeen-year period (Table VI - 11).

Skiing

The 1960 Winter Olympic games were held in nearby Squaw Valley, stimulating the development of winter sports in the Tahoe Region and providing international publicity. In 1960 an estimated 140,000 skier days were recorded for the North Shore area. This had grown to 700,000 by 1970, an increase of 400% in ten years. A similar but not as dramatic growth was experienced at the South Shore where skier days grew from 110,000 to 300,000 over the same time period (ERA 1971).

Outdoor Recreation

Outdoor recreation figures for the Tahoe Basin are not available for the 1950's; however, the U.S. Forest Service estimates an average annual growth rate of 2.25% in total forest land recreation (Smith, April 1973).

Access

Increases in the number of vehicles entering the region serve to indicate the nature of exogenous influence on the area. Traffic on

Highway 50 in El Dorado County has increased from an average daily count of 5000 in 1950 to 25,000 in 1972, a fourfold increase. Similarly traffic from the Basin to Carson City has increased from 900 per day to 6000 per day, over 500% increase. Only Highway 89 which provides access from Interstate 80 has failed to show a significant increase with only a 65% increase over the 22-year period. (California Department of Public Works, 1938-1972; Nevada Division of Highways, personal communication.)

APPENDIX B

STATUTORY AND REGULATORY CONTEXT

Since wastewater management and land use are interrelated, an understanding of the legal framework which guides these activities is necessary.

In both California and Nevada, jurisdiction over land use is vested in five levels of government: 1) the state, 2) the region, 3) counties, 4) cities, and 5) special districts. Of these five entities, cities, counties, and later the region, have been given primary legal jurisdiction for direct control of land use. The control exercised by the state and special districts, while important, has been largely indirect.

State Planning

Under the tenth amendment to the U.S. Constitution, all powers not specifically delegated to the Federal Government were reserved to the states. Control over land use was not one of the specifically enumerated federal powers and is therefore a matter of state responsibility. Both California and Nevada have state planning laws. (See, for example, California Government Code Title 7.) In both states, however, planning at the state level is largely limited to the location of major public facilities, such as state prisons, hospitals, highways, etc.

Primary authority over land use planning and control has been delegated to regional or local agencies. The source of this authority is the residual sovereignty of the state which permits government to regulate all human conduct within the jurisdiction of the state. This policing power has been delegated to subordinate levels of government by state constitutional provisions and by legislative enactment. The state of California and Nevada have so thoroughly divested themselves of their power over land use that very little of that power remains. The role of the state in land use planning is now largely limited to controlling the content and procedure of local and regional planning.

Regional Planning

California has long recognized the need for land use planning on a regional scale. The State Legislature has not, however, been willing to impose a workable system of regional planning. For this reason regional planning in California has been very weak. (See Marks and Taber, "Prospects for Regional Planning in California," Pacific Law Journal, p. 117.) While regional planning statutes do exist in California (Regional Planning Law, California Government Code section

65050 and District Planning Law, California Government Code section 66100), they are weak and seldom if ever used. With few exceptions all of the regional planning in California is conducted pursuant to the so-called Joint Powers Act (California Government Code section 6500). Most of the voluntary associations of governments formed under this statute have been organized for the purpose of receiving financial support for their planning activities under various federal programs. (Vestal, "Government Fragmentation in Urban Areas," 43 University of Colorado Law Review, p. 155.) Of these federal programs, those contained in Section 701 of the Housing Act of 1954 (40 U.S.C. sec. 461, 1970) and in Circular A-95, are probably the most potent. (See "Bureau of the Budget," Evaluation, Review and Coordination of Federal Assistance Programs and Projects, Attachment A-2, Circular No. A-95, July 24, 1969.)

The status of regional planning in Nevada has been similar to that of California. The difference seems to be that Nevada's legislators have been less willing than their colleagues in California to erect a statutory facade where no genuine commitment to regional planning exists. As a result Nevada has fewer unused planning statutes than California.

Clearly the most significant move toward regional planning in the Tahoe Basin was marked by the creation of the bi-state Tahoe Regional Planning Agency. This agency draws its authority from a bi-state compact adopted by California (California Government Code sec. 66800), Nevada (N.R.S. sec. 277,200), and subsequently ratified by Congress (83 STAT. 360, 1969).

In the course of developing this bi-state agency irreconcilable differences emerged between California and Nevada concerning the scope of planning power given to the agency. To overcome this political impass California created the California Tahoe Regional Planning Agency (California Government Code Title 7.5). The California agency was given powers not given to the bi-state agency. These powers, such as agency review of state initiated public works projects (California Government Code sections 67102 and 67103), may only be exercised in California. The California agency, however, serves as the California delegation to the bi-state agency. The meetings of the two agencies are held concurrently although the jurisdiction of the California delegation is somewhat broader than that of the bi-state agency.

The powers of the Tahoe Regional Planning Agency (TRPA) are broad (Tahoe Regional Planning Compact Article VI). They include the power to "adopt all necessary ordinances, rules, regulations and policies" necessary to carry out a regional land use plan. Among the most significant pieces of legislation thus far adopted by the TRPA is the Land Use Ordinance. The innovative regulatory approach embodied in this ordinance bases permitted land use on the ecological constraints of the land being regulated. The ordinance also contains a permit procedure which requires an applicant to submit a Land Capability Report before any administrative variance may be granted (TRPA Land Use Ordinance, February 10, 1972 Section 4.00).

Local Planning

Until the advent of the Tahoe Regional Planning Agency in 1969, all land use planning in the Tahoe Basin was undertaken by counties and cities. In California this power stems from three legal sources. The first is a general constitutional grant of power which provides that any city or county "may make and enforce . . . all such local, police, sanitary and other regulations as are not in conflict with general laws" (California Constitution, Article XI, sec. 11). The second is the so-called "home rule" section which applies to chartered cities and gives them exclusive legislative authority "in respect to municipal affairs" (California Constitution, Article XI, sections 6 and 8). The third is the Planning and Zoning Act (California Government Code sec. 65100-907). The constitution and statues of Nevada contain similar delegations of power to local government. There is serious question whether any coherent pattern of land use control can be achieved within the legal structure in which planning has traditionally been conducted (See Bowden, "Opening the Door to Open Space Control", Pacific Law Journal, p. 461; especially the sections on the evolution of zoning, p. 466 and zoning administration, p. 500).

Control of subdivision approvals is probably the most important local land use control mechanism. In California there are two statutes governing land subdivision: the Subdivision Map Act (California Business and Professions Code, sec. 11500 et. seq.).

The purpose of the Map Act is to provide a uniform means of reviewing and approving subdivision proposals submitted by landowners to cities and counties. It requires each city and county to adopt an ordinance outlining the procedures to be followed in reviewing and approving a proposed subdivision. These local ordinances must be consistent with the procedural requirements of the state statute. Under the Map Act a subdivision is defined as the division of one parcel of land into five or more parts. Before such a division may be permitted, the subdivider must secure city or county approval of a map designating new boundary lines, streets, etc. The statute does not guide local government in setting policy with respect to the kind, amount, or location of permitted subdivisions. The relationship between general planning and subdivision, therefore, is a political rather than a legal question.

In 1971, however, the law was amended to require, for the first time, that subdivision approval be consistent with an adopted general plan (California Business and Professions Code section 11526 (c)). This requirement was strengthened in 1973 by an amendment which prohibits a city or county from amending its general plan more than three times in one year (S. B. 594, California Statutes 1973, Chapter 120).

The second major statute governing subdivision in California is the Subdivided Lands Act enacted in 1933. Unlike the Subdivision Map Act, this statute is administered at the state level. It grants the State Real Estate Commissioner wide powers over the marketing of subdivided land. The most important of these powers is that requiring the Commissioner to issue a financial report on any subdivision before lots may be offered for sale to the public. The law applies to any subdivision, whether in California or in another state, which is marketed in California. The purpose of this law is to protect purchasers from the most common form of fraudulent land sale.

In recent years, several important amendments have been made to the Subdivided Lands Act. In 1971, for example, Article 2.5, dealing with "land project" provisions were designed to separate major subdivisions, such as those commonly undertaken in second home or recreational developments, from other forms of subdivision. A key provision prohibits the Commissioner from issuing a public report on a land project unless he makes a specific finding that the land project, if carried out, would be consistent with existing or proposed zoning for the area (California Business and Professions Code, sec. 11025(5)).

Nevada subdivision law is quite unlike that found in California. First, Nevada does not police the sale of subdivided land. The only limit on the resale of subdivided land is the requirement that the vendor first secure approval of a final subdivision map. And while Nevada does have a statute similar to the Subdivision Map Act, its provisions are far less rigorous than those of the California statute. The Bureau of Environmental Health does review all new subdivision proposals in the Tahoe Basin to insure water supplies are not contaminated and Water Pollution Regulations are not violated (Nevada State Division of Health, 1958 Reg. #8).

As in California, the Nevada law defines a subdivision as the division of one parcel into five or more parts. The law then carves out five exceptions which seem to swallow the rule. Any division of land which would otherwise qualify as a subdivision is expressly excluded from the map approval procedures if it: 1) is less than five acres, 2) abuts an existing street, 3) does not require street widening, 4) has secured approval of the lot design by local government, or 5) is larger than ten acres but divided for agricultural purposes (Nevada Revised Statutes 278.320).

Special districts

Special districts, like cities and counties, are governmental agencies which draw their authority from state law. As the name implies, the power of special districts is limited. Unlike cities and counties, they are not general purpose local governments. This means, for example, that they may not enact such things as zoning or subdivision ordinances. They may, however, condemn land for some purposes, enter into contracts, sue and be sued, levy certain taxes and assessments, sell bonds, and do whatever is necessary to perform the limited function for which they were created.

Since 1963 the formation of special districts in California has been subject to the approval of the Local Agency Formation Commission (LAFCo), (California Government Code sec. 54773, et. seq.). Under the LAFCo statute each county possesses its own commission, comprised of representatives from the county board of supervisors, city councils in the county, and a representative from the general public. The central task of LAFCo is to limit the number of new districts formed and to encourage districts to expand into contiguous areas rather than leave pockets of skipped-over territory. Under the statute no district may be formed or enlarged without LAFCo approval. The LAFCo has similar powers with respect to city annexations.

In the late 1950's and early 60's many districts were formed by second home subdividers in order to provide urban services without investing large sums of personal capital (Wood and Heller 1963). Often these districts were formed by the subdivider and his employees. District services were financed by general obligation bonds secured only by the land in the subdivision. No permission was needed to form the district and little supervision of its activities was exercised.

After the passage of the LAFCo statute in 1963, subdividers were less free to use the district law in promoting a subdivision. There is some doubt, however, whether the statutory change has caused a significant change in the subdivider's promotion technique. Under current practice, instead of forming a new district, the subdivider asks an existing district to annex his land as an "improvement zone." An improvement zone has nearly all of the legal powers of a district. It may, for example, sell general obligation bonds which are secured--not by the land in the original district--by the land in the subdivider's improvement district.

Since an established district may annex an improvement district without incurring any additional debt liability, there is little to deter it from complying with the subdivider's proposal. And when the improvement district sells its bonds, they are sold under the name of the parent district. Since the parent district has already established a credit rating the subdivider's task of selling these bonds is eased.

The only check on this procedure is the county LAFCo. The Local Agency Formation Commission Act, however, does not ask the LAFCo to consider the land use implications of a decision to permit an annexation to a district. The only requirement in the law is that such an annexation be "logical" and "orderly." Most LAFCO's have interpreted this to mean that an annexation to an existing district is preferable to the creation of a new district. The law does not give LAFCo the responsibility to achieve intergovernmental coordination of local planning and district services.

The central weakness of the law, therefore, is its failure to deal with the fact that the decisions made by a LAFCo have clear land use implications. Thus the law fails to integrate LAFCo into the overall planning process.

The statute is defective in another sense. It fails to guarantee adequate staffing for each county LAFCo. While each LAFCo is an arm of state government, it is wholly reliant upon county staff. In rural counties such as El Dorado and Placer the LAFCo may have no staff. Clearly a review body such as LAFCo can have little regulatory effect if it must perform under such a serious disability.

In Nevada the power to form special district resides in the county (N.R.S. Ch. 318.). Once created by the County Board of Commissioners, however, the district's governing Board of Trustees is free of any external regulation. It may annex any land it deems desirable and is not compelled to recognize the planning or other policies of cities or counties.

This freedom, however, is no longer accorded to Nevada's cities. In 1967 the Nevada Legislature created a City Annexation Commission (CAC) in each county with a population of between 100,000 and 200,000 (N.R.S. 268.626.). In some ways the CAC is similar to California's LAFCo. Each was created by state law; each functions at the county level; each was designed to achieve similar results; and each is composed of a similar membership. The central difference between LAFCo and the CAC is that the Nevada agency lacks jurisdiction over special districts.

This defect in the CAC has been partially ameliorated by Nevada's public utility law. In 1971 the Nevada Legislature enacted the Utility Environmental Protection Act (NRS 704.820 to 704.900). In adopting this new statute the Legislature declared that "it is essential . . . to minimize any adverse effect upon the environment . . . which new (utility) facilities might cause . . . Existing provisions of law may not provide adequate opportunity for individuals, groups interested in conservation and the protection of the environment, state and regional agencies, local governments and other public bodies to participate in . . . proceedings before the public service commission of Nevada regarding the location and construction of major facilities." (NRS 704.825.)

The statute, however, did far more than merely provide a forum for those interested in ventilating their concerns. It began by defining the word "utility" in broad terms. Included in the word "utility" are "sewer transmission and treatment facilities" (NRS 704.860). The statute also provides that "no public utility shall after July 1, 1971, commence to construct a utility facility . . . without first having obtained a permit therefore from the (Nevada Public Service)Commission" (NRS 704.865).

Before the Public Service Commission can grant a permit the applicant must submit a statement of "any studies which have been made of the environmental impact of the facility" and a statement of need and a description of the available alternatives (NRS 704.870). This language is not altogether clear. The section does stop short of requiring an environmental impact statement. It implies, however, that environmental impacts should at least be considered in the application.

These applications are then reviewed by the governor's environmental council and other interested parties. Following this review a hearing is held on the application. Parties to the permit proceeding include, among others, "any domestic non-profit corporation or association formed . . . to promote conservation . . . to protect the environment . . . to preserve historical sites, to promote consumer interests, to represent commercial and industrial groups, or to promote the orderly development of the areas in which the facility is to be located." Also a party is the governor's environmental council which is composed of virtually every state official claiming any interest in environmental quality (NRS 704.885).

No permit may be granted until the commission has determined, among other things, the need for the facility, the probable environmental impact resulting from it, and "that the facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations" (NRS 704.890).

The last quoted section could easily be read to emasculate the statute. The language "considering . . . other pertinent considerations" seems unnecessarily broad. The new sophistication implicit in this recognition, as recent as it is, should give environmental planners a scintilla of hope.

Bond Law

The most complex area of law in the field of local government is probably that which regulates the sale of bonds. California and Nevada have elaborate statutory provisions governing the sale, security and repayment of capital bonds. The importance of these statutes should not be minimized because the form of district capitalization plays a direct part in regulating the spiral of self-perpetuated urban growth.

A bond is nothing more than a promise to pay a specified debt at a fixed time. In California local agencies may use one of three means to generate the capital needed to finance district services. These are: general obligation bonds secured by the agency's taxing authority; revenue bonds secured by the income generated by the facility built with bond capital; and assessment bonds secured by either the individual parcels of land benefiting from the service facility or by a redemption fund backed by the aggregate of the land parcels benefiting from the service provided by the new facility.

General obligation bonds require a popular vote because they may be repaid through a special tax-rate levy. In case of default the bond holder may compel the agency to levy taxes necessary to retire the debt.

Revenue bonds are less secure than general obligation bonds because they may only be retired from the income generated by the facility which serves as security for the debt. If this revenue is insufficient to repay the debt, the bond holder's remedy is to foreclose on the sewage plant or other district facility. To resolve the difficulty of repaying revenue bonds in the initial years of operation, California law permits the district to levy a "stand by" charge against any parcel of land to which the district's service has been made available whether it is actually used or not. It is possible for these stand-by charges to be levied against land which is not legally developable under local zoning. Large areas of the Tahoe Basin which were formerly zoned for residential purposes but which are now zoned "general forest" are subject to sewer stand-by charges despite the fact that the service may not legally be used. This creates pressure for changes in zoning which would permit development. (Interview, Mr. William Layton, Tahoe City P.U.D. director, June 1973.)

Assessment bonds are common in California's second home communities because they permit the developer to shift the burden of repayment to the subsequent buyers of the subdivided land. There are three major statutes governing assessment bonds: 1) the 1911 Act, 2) the 1913 Act, and 3) the 1915 Act. These statutes can best be described as labyrinthine. The land-use consequences of this legal complexity has been summarized by a veteran professional in these words: "Cow county supervisors are bamboozled by flat-land bond attorneys who come before them with second home development schemes wrapped in the secret jargon of the bond law priesthood. Because politicians are reluctant to admit their basic ignorance of bond law, these fast-talking lawyers are never questioned very hard about the financial side of their projects." (Interview, Tom Willoughby, Consultant to the California Legislature's Committee on Local Government, July 24, 1973).

Nevada bond law is also complex, but like most aspects of Nevada law it is much less so than its California counterpart. Two statues regulate the sale and repayment of bonds (Local Government Securities

Law, NRS 350.500-720 and the General Improvement District Law, NRS Chapter 318).

Districts may issue the following securities: short-term notes; warrants and interim debentures; general obligation bonds; revenue bonds; and special assessment bonds (NRS 318.275).

There are two kinds of general obligation bonds. One is secured by the property tax; the other carries the additional security of a "pledge of and lien on net revenues." (NRS 318.325). Both forms of general obligation bond require voter approval (NRS 318-290).

Revenue bonds are secured by "a pledge of and lien on" the net revenue of the district and do not require a popular vote (NRS 318.320). The statute prohibits using the proceeds of any district property tax as security for revenue bonds (NRS 318.325).

Assessment bonds are secured by the lots and parcels of land assessed for the bond debt. The assessments levied against these parcels is deposited into a sinking fund. The district must levy a special property tax to make up any deficiency to the sinking fund as bond debts become due (NRS 318.480).

APPENDIX C

POPULATION PROJECTIONS

In a recreational-based economy such as that at Lake Tahoe, it is extremely difficult to make an accurate count of existing population and even more difficult to predict future levels due to fluctuating seasonal recreation uses (Environmental Sciences, Inc., 1963, p 27). Since utility district must cope with peak demand periods, it is essential that peak populations be both accurately measured and carefully projected to provide data to guide wastewater districts in determining future infrastructure needs.

In urban areas, population data compiled by the U.S. Census Bureau at 10 year intervals provides adequate information on existing population levels. Census data has not been disaggregated for the Tahoe Basin. Permanent residents are counted relatively accurately by census methods but seasonal residents, short-term visitors, and day users who together make up the largest segment of peak population levels, are not. A memorandum report issued in late 1971 by the California Department of Water Resources reported,

> There is no accurate up-to-date information on visitation in the Lake Tahoe Basin. Actual counts of the number of people present at one time throughout the year have not been made since the 1948 investigation by the State Engineers of California and Nevada. Therefore, figures for subsequent historical peak season population and annual visitor-days are estimates of unknown accuracy. (Turner 1971, no paging)

Due to this lack of accurate historical data describing the growth of various sectors of the population, planners and consultants were forced to use other means to formulate long-term population projections.

A discussion of the most important population projections made for the Basin follows, including the methods used by consulting engineers to determine wastewater system sizing and phasing. It is important to note that these projections were used during the period of time that the largest expenditures of public and private funds for wastewater facility construction and expansion were made.

In a 1968 study for Incline Village GID, the consultants stated, "The saturation population for the District, based on the '1963 Report,' will be about 48,000" (Clair Hill 1968, p C-2). "Based on a projected peak population of 48,000 and 100 gallons per day per capita, ultimately sewage flows from the District should reach at least 4.8 million gallons on maximum days" (Clair Hill 1968, p E-1). After noting that other areas adjacent to the district "may wish to avail themselves of sewerage service through the Incline system" (Clair Hill 1968, p E-1), the consultants concluded, "A maximum daily flow of 4.8 to 5.5 million gallons therefore appears to be reasonable for long-range planning" (Clair Hill 1968, p E-2). Their recommendation was that the treatment plant and export system "provide for total flows of 3.0 mgd and be readily expandable to capacities of 5.5 mgd) (Clair Hill 1968,p E-2). The population projection for Incline Village made in the comprehensive study by Environmental Science, Inc. (ESI 1963), had a great influence on wastewater management planning in that district.

In 1959, STPUD contracted with the consulting firm of Brown and Caldwell to conduct a study of future population, land use and facility requirements for the STPUD "ultimate service area." The report states, "Because the South Tahoe community is of relatively recent origin and is currently developing at an exceptionally high rate, it is extremely difficult to base population predictions on any of the so-called normal methods" (Brown and Caldwell 1959, p 31). They made the attempt, however.

Since there were no local long-term statistics on which to base a 50 year population projection, the consultants found only four short-term local indices to predict a high rate of population growth for the next 50 years. These indicators were:

Electrical service customers - 1947-57
Postal receipts of four Basin post offices - 1950-57
School enrollments - 1947-57
Vehicular traffic on Highway 50 - 1953-57

The report went on to state:

> Taken together, all of the above listed factors reflect a definite trend with respect to population development. They indicate that the resident or permanent population increased slowly but steadily during the first half of the present decade. They further indicate that a greatly accelerated rate of growth began in 1955 and that the presently apparent trend is likely to continue for a good many years. (Brown and Caldwell 1959, p 33)

Since 1957 was the last year for which information was available, the "presently apparent trend" had lasted a total of three years. In addition to growth rate, a population holding capacity or ultimate saturation population had to be determined by predicting land use.

El Dorado County was in the midst of formulating their first Master Plan for the South Tahoe area. The utility consultants, rather than waiting for the county to complete its plan, proceeded to fabricate a hypothetical land use plan on their own for the proposed bi-state service area.

The report projects urban-type land uses for 97% of the developable land within the proposed ultimate district boundaries, including many hundreds of acres of US Forest Service lands The Table C-1 shows the figures used to calculate the predicted saturation population of the STPUD service area.

		High estimate		Low estimate		Average estimate	
Land classification	Area, acres	Unit density[a]	Total	Unit density[a]	Total	Unit density[a]	Total
High density residential	5,340	16	85,000	8	43,000	12	64,000
Medium density residential	10,450	10	104,000	3	31,000	7	73,000
Low density residential	9,480	4	38,000	2	19,000	3	29,000
Commercial	1,410	60	85,000	45	63,000	52	73,000
Public lands	360	10	4,000	10	4,000	10	4,000
Recreational	470	0	-	0	-	0	-
Unhabitable lands	2,330	0	-	0	-	-	-
Total	29,840		316,000		160,000		243,000

Table C-1 Predicted Saturation Population of Service Area

Source: Brown and Caldwell 1959, p. 35.

A brief examination of the above table indicates that the protection of environmental quality was of marginal importance in assigning land use categories to undeveloped lands. There was no mention in the study of increased erosion caused by residential development of steep lands, with the attendant deleterious effect on water quality of the lake. No mention was made of the decreased recreational suitability of the area due to over-crowding, visual degradation, loss of public access and the almost complete loss of open space in close proximity to the lake. The composite of assumptions used by Brown and Caldwell to formulate their land use plan seems to clash with a basic assumption of the study--that the area would continue to function on a predominately recreational economy. The loss of these scenic amenities could well have ended the spiraling growth of the Basin before development reached the level predicted by this study.

This lack of concern for environmental quality quality issues is also evident in assumptions and criteria used in the 1961 study by the Real Estate Research Corp. for the Basinwide 1980 Regional Plan Program, and the 1963 study by Engineering Sciences, Inc.for the Lake Tahoe Area

Council. The 1980 Plan study described three possible directions that future development in the Basin could take. The alternative selected to form the basic foundation of the 1980 plan was described in the plan as follows:

> Progression to a Developed, Urban Economy
>
> ... The values of the resident population whose primary concern is commercial development within the region are stressed. The scenic quality of the environment is regarded as a function of profit. This alternative gives greater weight to economic growth rather than to aesthetic conservation." (Wilsey et al, 1963, p. 36).

An attitude where "the scenic quality of the environment is regarded as a function of profit" definitely puts environmental quality concerns behind economic growth concerns. This 1980 plan projecting 313,000 peak summer residents by 1980 was based on the assumption that any activity necessary to encourage, accommodate or accelerate population growth (highway and freeway construction to improve access; sewer, water and power facility expansion to allow increased housing densities; land trades to allow private development of public lands administered by the US Forest Service) would be done (Wilsey et al 1963, p. 15).

The 1963 study of ESI was the most influential Basinwide study. The study included the first estimated costs of sewage export. The report shows little concern for environmental resources, however. The lack of a sufficient water supply to support the ultimate projected populations entered into calculations of the impact of exporting sewerage:

> Water use and hydrologic studies of the Truckee River Basin have led to the general conclusion that there is insufficient water to meet all probable future demands, hence the Basin is considered a water deficient area. Based on a total Basin water allocation of 34,000 acre feet, a DWR estimate that 70% of total water consumed would be returned as sewage flow, and assumed export of all effluents from the Basin, it was calculated that in dry years such as 1931 and 1932, there would be no flow in the Truckee River at Tahoe City . . . (ESI 1963, Section VII)

This acknowledged limitation to population growth was ignored in formulating and projecting future population growth in the study, however.

Figure C-1 illustrates the most important projections of peak summer population and ultimate saturation population made over a 24-year period. A clear trend is shown toward higher peak summer/ultimate saturation populations until 1971, when the land capability-based TRPA plan was adopted. The environmental constraint criteria used by TRPA

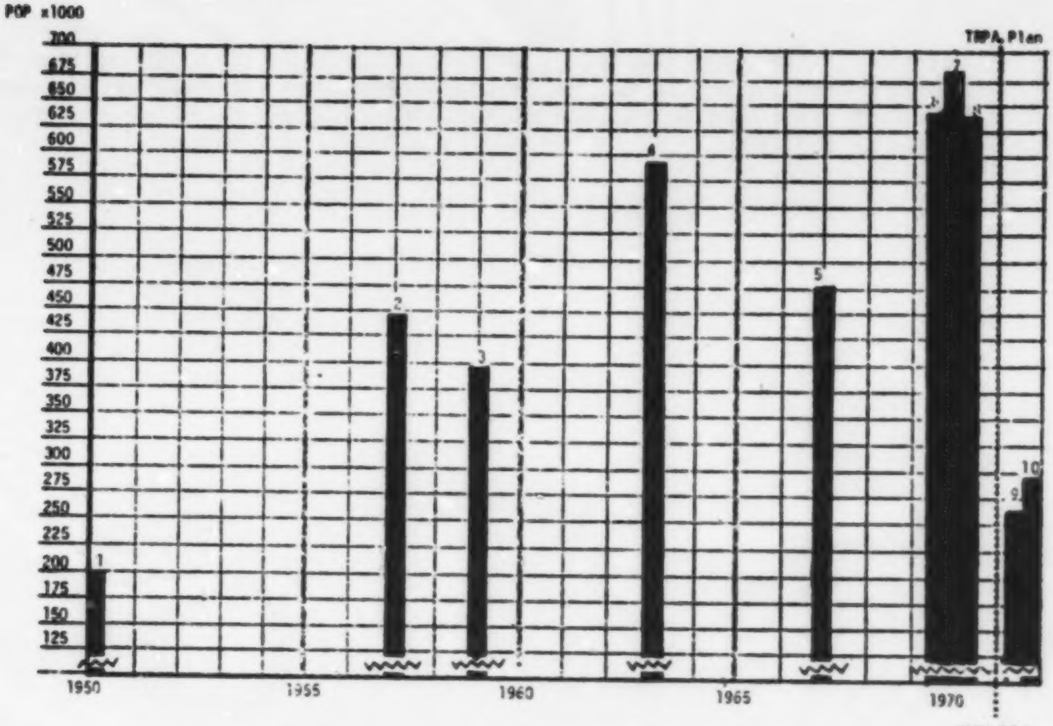

Figure C - 1: COMPARISON OF ULTIMATE/SATURATION POPULATION PROJECTIONS

1. 200,000 by 1998, Department of Water Resources in "Joint Report on the Use of Water in the Lake Tahoe Watershed", June, 1949.

2. 449,700 at saturation, Department of Water Resources in "Lake Tahoe Population and Water Use Survey", April, 1957.

3. 398,000 at saturation, Department of Water Resources in "Estimated Future Water Requirements-- Lake Tahoe Basin", August, 1959.

4. 596,000 by 2010, Engineering-Science, Inc for the Lake Tahoe Area Council in "Comprehensive Study on the Protection of Water Resources of Lake Tahoe Basin Through Controlled Waste Disposal" June, 1963.

5. 475,400 by 2010, Engineering-Science, Inc for the Lake Tahoe Area Council in "A Regional Program for the Protection of Water Resources in the Lake Tahoe-Truckee River Basin", 1967.

6. 648,100 holding capacity, Department of Water Resources based on "1956 Land Classification Survey" in a report by Central District office dated January 19, 1970.

7. 680,960 in 2010, Nevada Division of Water Resources, cited in Raymond M. Smith, "Nevada Tahoe General Plan", January, 1970.

8. 644,000 in 2020, Department of Water Resources, Central District August, 1970.

9. 266,000 at saturation, Eckbo, Dean, Austin & Williams in preliminary work on "Tahoe Population Estimates and Projections", for TRPA, June, 1972.

10. 236,700 to 290,350 by 1990-2000, Economic Research Associates in "Regional Housing Element Update" for TRPA, December, 1972.

in the formulation of their land use plan significantly lowered the ultimate peak populations predicted by earlier studies. If environmental quality had been included among the factors used to determine the earlier population projections, the disparity between these projections and the TRPA projections would be considerably smaller.

APPENDIX D

STATISTICAL ANALYSIS

In seeking to establish quantitative relationships between land development and wastewater management, selected statistical tests were applied to the data sets expressing these two activities. Section VI provided a summary of the statistically significant results of these tests. However it is useful to discuss some areas where tests results imply important relationships but were not statistically significant, and thus suggest areas for further research.

This appendix provides such a discussion, and is organized around three statistical tests: correlations, factor analysis, and linear regression.

Correlation

Pearson Product Moment Correlation Coefficients measure the degree of relationship between pairs of variables. These coefficients range between -1 through 0 to +1; a correlation of zero indicates an independence between two phenomena, while a high correlation indicates a linear relationship, i.e., one variable increases as the other increases (positive correlation) or one increases as the other decreases (negative correlation). If the value of the coefficient passes the significance level (a function of the sample size and chosen confidence level), the hypothesis of linear independence between the two variables is rejected.

It is possible to determine the statistical significance of the difference between two correlations, however the difference between coefficients would have to be very large for a small sample size. Although our calculated coefficients range from .40 to .99, it is only possible to classify them into three actual categories--significantly positive, significantly negative, or zero--due to the small number of observations (ranging from 5-23).

Initially, fifteen variables were selected for computation of Pearson's Correlation Coefficients. These variables were selected to reflect five categories: land use, wastewater management, tourism, population, and market influences. The following discussion examines the results of a county by county analysis.

El Dorado County--(Table D-1) The 105 discrete correlation coefficients are all statistically significant with a high percentage significant at the .001 level. Two important observations should be made: all correlations indicate a positive relationship; and the small sample size (years of observation) prohibits differentiation of strengths between variables. In sum, the correlation matrix merely indicates the entire array of variables has a significantly positive relationship.

While it is true that all the factor quantities have increased during the 23-year period, it is nevertheless surprising that the entire array is significantly related. The nature of this positive relationship may indicate future difficulty in determining the specific structure of the relationships.

Placer County--(Table D-2) Of the 105 iterations in the Placer County matrix, only one negative correlation appears (wastewater flows with prime interest rate) although the significance level is not statistically valid. With this exception the same observations hold as for those cited for El Dorado County.

Douglas County--(Table D-3) No important differences were observed in the Douglas County coefficients. The five coefficients which are not statistically significant all involve permanent population figures which contain data gaps thus providing a likely explanation for a lack of correlation.

Washoe County--(Table D-4) Of particular note is the coefficient for the Incline Village GID service area. Since the district size has remained the same since its formation in 1962, it is the only variable which has remained constant and no coefficient could be computed for the variable. In addition, the other two wastewater variables failed to have statistical significance in a number of cases. Eight variables failed to produce a significant correlation with average daily flow: building permits for multiple units, subdivision lot approvals, plant capacity, traffic, skier days, permanent population, primary market area and prime interest rate. The lack of correlation with average daily flow may be attributed to the fact that only five yearly observations are available for flow data. Plant capacity fails to correlate significantly with permanent population and prime interest rate; in this case the quality of data may explain the lack of significance in the coefficients.

Summary--With the exceptions noted above, all land use, wastewater management, tourism, population, and market influence variables show a strong positive relationship. The constraints imposed by the statistically small number of observations seriously limit the interpretation of the results, and no internal statistical differentiation is possible.

Factor Analysis

Factor Analysis is a statistical method for detecting underlying factors or characteristics in a group of variables. Those variables

	Single Family Building Permits	Multiple Family Building Permits	Subdivision Lot Approvals	Assessed Value	Plant Capacity	Service Area	Average Daily Flow	Traffic Volume	Gaming Revenues	Skier Days	Basin Permanent Population	County Permanent Population	Population Projections (Basin)	Primary Market	Prime Interest Rate
Single Family Building Permits	1.00														
Multiple Family Building Permits	.98	1.00													
Subdivision Lot Approvals	.94	.93	1.00												
Assessed Value	.99	.98	.98	1.00											
Plant Capacity	.76	.78	.91	.89	1.00										
Service Area	.85	.84	.98	.89	.93	1.00									
Average Daily Flow	.97	.96	.90	.94	.65	.80	1.00								
Traffic Volume	.74	.77	.93	.88	.76	.83	.89	1.00							
Gaming Revenues	.98	.96	.88	.99	.88	.90	.98	.89	1.00						
Skier Days	.90	.88	.97	.93	.89	.92	.83	.68	.94	1.00					
Basin Permanent Population	.99	.98	.98	.99	.88	.90	.97	.93	.98	.89	1.00				
County Permanent Population	.93	.93	.79	.90	.54	.65	.89	.86	.86	.72	.94	1.00			
Population Projections (Basin)	.98	.96	.99	.99	.91	.91	.92	.85	.99	.96	.98	.85	1.00		
Primary Market	.98	.97	.98	.99	.84	.88	.93	.72	.98	.95	.98	.88	.90	1.00	
Prime Interest Rate	.64	.66	.89	.81	.86	.79	.53	.82	.74	.71	.88	.67	.78	.74	1.00

Table D - 1: CORRELATION COEFFICIENTS -- EL DORADO COUNTY

	Single Family Building Permits	Multiple Family Building Permits	Subdivision Lot Approvals	Assessed Value	Plant Capacity	Service Area	Average Daily Flow	Traffic Volume	Gaming Revenues	Skier Days	Basin Permanent Population	County Permanent Population	Population Projections (Basin)	Primary Market	Prime Interest Rate
Single Family Building Permits	1.00														
Multiple Family Building Permits	.89	1.00													
Subdivision Lot Approvals	.96	.79	1.00												
Assessed Value	.97	.96	.94	1.00											
Plant Capacity	.77	.96	.68	.84	1.00										
Service Area	.98	.93	.84	.94	.83	1.00									
Average Daily Flow	.78	.75	.65	.70	.62	.65	1.00								
Traffic Volume	.97	.91	.97	.97	.76	.89	.64	1.00							
Gaming Revenues	.99	.93	.96	.98	.75	.92	.76	.97	1.00						
Skier Days	.94	.82	.95	.91	.67	.96	.62	.91	.92	1.00					
Basin Permanent Population	.96	.77	.98	.92	.61	.79	.74	.97	.96	.92	1.00				
County Permanent Population	.97	.95	.94	.99	.81	.94	.74	.98	.98	.92	.93	1.00			
Population Projections (Basin)	.99	.87	.96	.96	.65	.89	.71	.97	.98	.96	.98	.98	1.00		
Primary Market	.98	.83	.99	.94	.70	.93	.69	.97	.96	.96	.98	.95	.99	1.00	
Prime Interest Rate	.64	.57	.89	.82	.57	.77	-.08	.88	.72	.76	.88	.73	.78	.74	1.00

Table D - 2: CORRELATION COEFFICIENTS -- PLACER COUNTY

	Single Family Building Permits	Multiple Family Building Permits	Subdivision Lot Approvals	Assessed Value	Plant Capacity	Service Area	Average Daily Flow	Traffic Volume	Gaming Revenues	Skier Days	Basin Permanent Population	County Permanent Population	Population Projections (Basin)	Primary Market	Prime Interest Rate
Single Family Building Permits	1.00														
Multiple Family Building Permits	.98	1.00													
Subdivision Lot Approvals	.92	.90	1.00												
Assessed Value	.96	.95	.97	1.00											
Plant Capacity	.78	.80	.80	.88	1.00										
Service Area	.88	.87	.87	.95	.91	1.00									
Average Daily Flow	.95	.94	.75	.86	.66	.80	1.00								
Traffic Volume	.72	.72	.92	.72	.58	.71	.87	1.00							
Gaming Revenues	.98	.96	.97	.98	.76	.89	.89	.86	1.00						
Skier Days	.91	.90	.94	.97	.89	.97	.80	.69	.94	1.00					
Basin Permanent Population	.90	.99	.97	.94	.71	.84	.97	.93	.98	.89	1.00				
County Permanent Population	.94	.96	.96	.91	.78	.77	.80	.53	.93	.83	.98	1.00			
Population Projections (Basin)	.98	.97	.97	.99	.79	.90	.89	.85	.99	.96	.98	.93	1.00		
Primary Market	.99	.98	.94	.98	.84	.92	.92	.72	.98	.94	.98	.95	.99	1.00	
Prime Interest Rate	.69	.71	.86	.71	.79	.82	.63	.82	.74	.71	.89	.78	.78	.74	1.00

Table D - 3: CORRELATION COEFFICIENTS -- DOUGLAS COUNTY

	Single Family Building Permits	Multiple Family Building Permits	Subdivision Lot Approvals	Assessed Value	Plant Capacity	Service Area	Average Daily Flow	Traffic Volume	Gaming Revenues	Skier Days	Basin Permanent Population	County Permanent Population	Population Projections (Basin)	Primary Market	Prime Interest Rate
Single Family Building Permits	1.00														
Multiple Family Building Permits	.81	1.00													
Subdivision Lot Approvals	.82	.99	1.00												
Assessed Value	.88	.97	.97	1.00											
Plant Capacity	.54	.77	.72	.72	1.00										
Service Area															
Average Daily Flow	.86	.78	.78	.82	.78		1.00								
Traffic Volume	.91	.96	.92	.97	.68		.73	1.00							
Gaming Revenues	.98	.96	.93	.98	.79		.82	.97	1.00						
Skier Days	.89	.89	.90	.96	.55		.72	.91	.92	1.00					
Basin Permanent Population	.99	.85	.82	.91	.59		.85	.97	.96	.92	1.00				
County Permanent Population	.82	.58	.56	.80			[illegible]	.58	.79	.89	.88	1.00			
Population Projections (Basin)	.95	.93	.90	.98	.68		.82	.97	.98	.96	.98	.84	1.00		
Primary Market	.97	.91	.91	.96	.62		.80	.97	.96	.96	.98	.85	.99	1.00	
Prime Interest Rate	.66	.66	.78	.70	.02		.33	.88	.72	.76	.88	.68	.79	.74	1.00

Table D - 4: CORRELATION COEFFICIENTS -- WASHOE COUNTY which share common variance and therefore are assumed to be related are grouped together under one factor. By reducing a cluster of related variables into one theoretical construct (a factor) the researchers can then deal with fewer measures in further analysis. This grouping will also demonstrate relationships that may not be evident from the original correlation matrices.

The large number of variables which exhibit strong positive correlations in the land development process suggest the application of factor analysis to reduce the number of variables and cluster those which tend to vary as a group. The fifteen variables selected for correlation analysis were initially entered into the SPSS factor analysis routine without designating the number of desired factors. The number of factors generated ranged from four in Washoe County to one in Douglas County, however the clusters of variables determined did not suggest any logical structure.

A second set of factor matrices was subsequently computed with a predesignation of six factors. The resulting clusters of variables again proved inconclusive for further analytical purposes. Table D-5 indicates the relative strength and composition of this second set of factors.

		FACTOR					
		1	2	3	4	5	6
COUNTY	EL DORADO	Wastewater Service Area Prime Interest Rate	Traffic	Wastewater Assessment Area	Wastewater Plant Capacity Wastewater Service Area *Total Flows	Permanent Population	Subdivision Approvals Gaming Revenues Skier Days Population Projection *Permanent Population
	PLACER	Prime Interest Rate	Wastewater Service Area Wastewater Assessment Area	Building Permits--Multiple Assessed Valuation Plant Capacity	Skier Days Wastewater Service Area	Wastewater Daily Flows *Wastewater Service Area	Building Permits--Single Family Subdivision Approvals Permanent Population Projected Population Primary Market
	DOUGLAS	Permanent Population Wastewater Total Flows Wastewater Daily Flows	Prime Interest Rate	Traffic	Skier Days Wastewater Service Area	Building Permits--Multiple & M/H Wastewater Plant Capacity	Subdivision Approvals Assessed Valuation Gaming Revenues Projected Population
	WASHOE	Building Permits--Single Family Subdivision Approvals Permanent Population Wastewater Service Area	Skier Days Wastewater Cost	*Wastewater Plant Capacity Prime Interest Rate	Wastewater Daily Flows	Building Permits--Multiple & M/H Assessed Valuation Projected Population *Wastewater Service Area Primary Market	Building Permits--M/H Gaming Revenues Wastewater Total Flows

*Negative Influence

Table D-5 SUMMARY OF FACTOR ANALYSIS (Factors above .30 level)

Linear Regression

Stepwise Multiple Regressions determine which variables best explain or predict the variation in others. In the SPSS procedure, the first independent variable to enter the prediction equation has the highest correlation with the dependent variable. The remaining independent variables are entered one at a time in an order such that each step maximizes the explained variation. Thus when all variables with significant contributions to the prediction equation have been entered, their ordering theoretically shows a hierarchy of importance in the explanation of variation in the dependent, or predicted variable. At each step an F statistic is calculated to test the significance of variation accounted for at that step (R^2). This statistic is then compared to a table of the F distribution under the appropriate number of degrees of freedom (a function of the number of variables already in the equation and the number of observations, or years, on which the equation is based). Positive correlations cannot be distinguished from one another using small sample sizes, and if these are the basis of the multiple regression steps, the resulting prediction equation is indeterminate.

Through the use of linear regression, the degree of dependence between variables can be determined, and causality can be inferred if the independent variable clearly precedes the dependent variable in time.

Using county-specific data, regression equations were calculated for selected dependent variables. Since reliable time series data were limited to El Dorado and Placer Counties, regression equations were computed for only these two units.

The following data constituted the dependent variables not discussed in Section VI: wastewater treatment plant flows, wastewater service district area, subdivision lot approvals, building permits issued, population projections (from 1980 Plant prepared in 1963), and primary market population. (These dependent variables provide measures of wastewater management, land use, and exogenous factors.)

The following discussions are based on Tables D-6 and D-7 which summarize the results of the stepwise regressions for El Dorado and Placer Counties respectively. (Note: These Tables contain only the sequence and R^2 coefficient of determination for variables with statistical significance.)

Wastewater flows

Building permits constitute the only significant R^2 in explaining treatment plant flows, thus indicating that single family building permits at the North Shore, and total building permits at the South Shore are the best indicators of increased flows.

DEPENDENT VARIABLES	INDEPENDENT VARIABLES AND R^2			
	Step 1	Step 2	Step 3	Step 4
Treatment Plant Total Yearly Flow	Total Building Permits (.96)	STPUD Service District Area (.98)		
Subdivision Approvals	Gross Gaming Revenues (.94)	Treatment Plant Capacity (.98)	Plant Yearly Flow (.99)	
Total Building Permits	Plant Yearly Flow (.96)	STPUD Service District (.98)		
STPUD Service District Area	Gross Gaming Revenues (.86)	Treatment Plant Capacity (.91)	Subdivision Approval (.93)	
Population Projection -- 1980 Plan	Subdivision Approval (.97)			
Primary Market	Subdivision Approval (.97)	Total Building Permits (.99)		

Table D - 6: SUMMARY OF STEP-WISE REGRESSION EQUATIONS-- EL DORADO COUNTY

R^2 significant at .01 unless noted

DEPENDENT VARIABLES	INDEPENDENT VARIABLES AND R^2			
	Step 1	Step 2	Step 3	Step 4
NTPUD and TCPUD Average Daily Flows	Single Family Building (.78)* Permits			
NTPUD and TCPUD Service Area	Permanent Popula- (.90) tion	Ski Days-- North (.96) Shore	NTPUD & TCPUD Plant (.98) Capacity	
Population Projection -- 1980 Plan	NTPUD & TCPUD Service (.96) Area	Traffic Volume (.98)	NTPUD & TCPUD Plant (.99) Capacity	
Primary Market	NTPUD & TCPUD Service (.96) Area	Subdivision Approval (.98)		
Subdivision Approvals	Permanent County (.88) Population	Multiple Family Motel/ (.94) Hotel Building Permits	Traffic Volume (.97)	Single Family Building (.99) Permits
Single Family Building Permits	Traffic Volume (.98)			

Table D - 7: SUMMARY OF STEP-WISE REGRESSION EQUATIONS--PLACER COUNTY

R^2 significant at .01 unless noted
* significant at .05

Wastewater Service

Annexations to service districts are statistically explained by 1) gross gaming revenues, 2) treatment plant capacity, and 3) subdivision lot approvals in the south; and 1) permanent population, 2) skier days, and 3) plant capacity in the north.

Subdivision Lot Approvals

Gross gaming revenues provide the initial regression variables in El Dorado County, followed by plant capacity; while in Placer County the first step variable is permanent population and the second step variable is multiple and motel/hotel building permits. The contrast between the two counties may indicate that El Dorado County subdivision activity is stimulated by the South Shore gaming (either through direct economic activity or through high visitor days), and Placer County subdivision activity reflects demand through population and construction. This in turn may indicate a stronger regulation of land use in Placer County in contrast with El Dorado County's implicit support of extensive land speculation.

Building Permits

Wastewater management variables enter the first two steps of the regression equation for El Dorado County building permits. Treatment plant yearly flow is the first step variable ($R^2 = .96$) with STPUD service district contributing .02 for an R^2 of .98 after two steps. In Placer County only one variable, traffic volume, enters the regression, contributing a .98R^2 as the initial variable.

The relationship in El Dorado County between building permits and wastewater flows would normally be expected. However, the relationship between building permits and traffic volume in Placer County may indicate a high number of seasonal residents and short-term visitors.

Population Projections

It is clear from the research described in Appendix C that population projections have played a central role in wastewater management facility planning at Lake Tahoe. Therefore, a regression equation has been computed using as a dependent variable the population projection developed by Wilsey, Ham and Blair for the 1980 Regional Plan (prepared in 1963).

El Dorado County--Subdivision approvals are the primary step variable, resulting in a .98 coefficient of determination. The contribution of sequential variables is extremely small although statistically significant (gaming revenues, wastewater management plant capacity, and wastewater flows follow in the subsequent steps). Since subdivision approvals at Lake Tahoe are in considerable excess of actual demand (30,000 vacant lots), one could argue that population projections were not accurate projections of demand, but rather influences contributing to an oversupply of subdivided land.

Placer County--Significant differences are again apparent between the two case study counties. Wastewater service area, traffic, and treatment plant capacity are the first three variables in the North Shore equation, resulting in a coefficient of determination of .99 in the third step. The absence of subdivision approvals and the appearance of two wastewater measures in the first three regression steps indicates a totally different response to population projections between the North and South Shores. From the results of the regression it would appear that the expansions of wastewater management facilities were considerably influenced by high population projections.

Primary Market Population

As anticipated, subdivision approvals are first and second step variables in the primary market equations; total building permits follow subdivision approvals in El Dorado County, and service area growth precedes subdivision approvals in Placer County.

APPENDIX E

LAND USE AND WASTEWATER MANAGEMENT DATA SETS

This appendix is an index to the time-series data sets and the reporting units which were used in the quantitative analysis section of this report. It is presented here to provide background information for the reader. Actual data are compiled in a supplementary appendix.

1. Subdivision Approvals--County
    a. single family residential (lots)
    b. multiple family residential (units)
    c. cumulative (lots)
2. Building Permits--County
    a. single family residential (permits)
    b. motel/hotel (units)
    c. multiple family (units)
    d. cumulative, each category above (permits or units)
    e. total (units)
    f. cumulative total (units)
3. Housing Units--County
    a. single family residential (units)
    b. motel/hotel (units)
    c. multiple family residential (units)
    d. total (units)
4. Assessed Valuation--County (dollars)
5. Treatment Plant Capacities--Wastewater Management District (gallons)
6. District Annexations--Wastewater Management District (acres)
7. Assessment District Size--Wastewater Management District (acres)
8. Total Service Area--Wastewater Management District (acres)
9. Recorded Plant Flows--By Wastewater Management District
    a. average daily flow (gallons)
    b. total yearly flow (gallons)

10. Capital Costs--Wastewater Management District
    a. federal (dollars)
    b. state (dollars)
    c. local (dollars)
    d. cumulative for each category above (dollars)
11. Gaming Revenues--County (dollars)
12. Vehicles Entering Tahoe Basin
    a. Highways 50, 89, 19, 27 (average vehicles per day)
13. Recreation Activity--North Shore; South Shore
    a. skier days (user days)
    b. outdoor recreation (user days)
14. Utility Customers, South Shore
    a. electrical services (service connections)
    b. telephones (service connections)
    c. STPUD (service connections)
15. Population--County
    a. permanent (persons)
    b. seasonal (persons)
    c. peak (persons)
16. Total Basin Population
    a. permanent (persons)
    b. seasonal (persons)
    c. peak (persons)
17. Peak Population Projections--Total Basin
    a. 1980 Plan; 1963 (persons)
    b. ESI; 1963 (persons)
    c. Ray Smith; 1973 (persons)
18. Primary Market Area (families)
19. Prime Interest Rate (percent)